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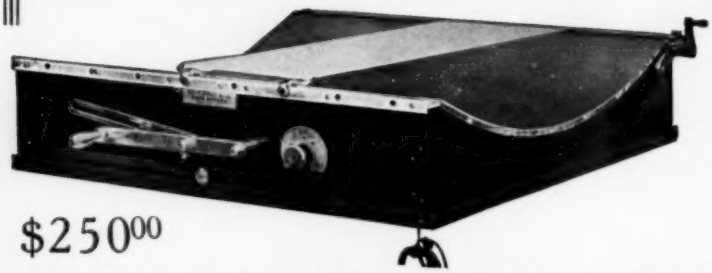

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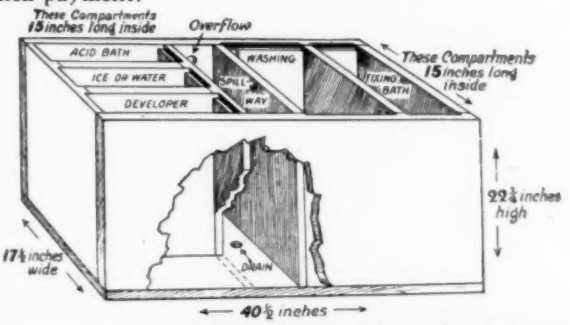

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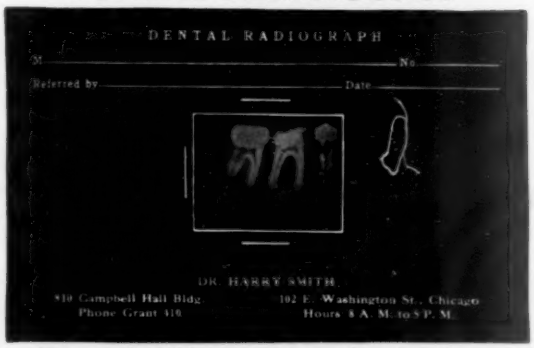

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XVI JULY, 1926 No. 1

COLON STUDIES. III. THE CLINICAL SIGNIFICANCE OF ILEAL STASIS: ITS ASSOCIATION WITH COLITIS*

BY JOHN L. KANTOR, M.D.

NEW YORK CITY

WITH the single exception of Renaudeaux's Paris thesis apparently nothing of importance has been added to the literature of ileal stasis during the past decade. The impressions then advanced and still largely current may be roughly summarized as follows:

1. Ileal stasis is commonly associated with mechanical obstructions due to kinks or adhesions (Lane, Jordan).

2. Ileal stasis is commonly associated with acute or chronic appendicitis (Hurst, George and Gerber).

3. Ileal stasis is associated with insufficiency of the ileocecal valve (Case, Kellogg).

3. Ileal stasis is associated with constipation, particularly in the proximal colon (Cole).

A review of the entire subject *de novo* seems timely. With the assistance of Dr. Samuel Schechter, I have gone over my private material and have submitted it to a critical analysis. Both "positive" (stasis) and "negative" (non-stasis) cases were subjected to the same statistical treatment for the consideration of each basic factor. This method is the one previously employed in my studies on the colon. It offers the advantages of being objective, as free as possible from preconceived bias, and should expose automatically whatever inherent weaknesses exist in either the plan of attack or the conclusions drawn from the facts elicited.

Although the present investigation has already yielded certain interesting findings, I labor under no delusion that I have done more than graze the surface. Only the colonic aspects of ileal stasis have been thus far considered; the small intestinal factors have yet to be studied. Nevertheless it is hoped that this paper will serve to reopen a healthy interest in this fascinating subject, and will stimulate further and more far-reaching investigations.

MATERIAL

This study is based on 161 cases in which the emptying of the ileum was observed *satisfactorily* after the administration of a standard opaque meal. These cases were selected from a gross series of 217 consecutive "9-hour" observations, the odd 56 being excluded for various technical reasons, the chief of which was failure of the stomach to empty completely within six hours after the meal was ingested.

The 161 cases (referred to hereafter as the "9-hour series") constitute a part of a series of 801 roentgen studies on 1576 office patients complaining of gastrointestinal symptoms. This larger group is the same, brought down to date, as has furnished the material for the previous studies of this series. Practically every one of

* Read before the PHILADELPHIA ROENTGEN RAY SOCIETY (by invitation) March 4, 1926; also at the Twenty-ninth Annual Meeting of the American Gastro-Enterological Association, Atlantic City, N. J., May 3, 1926.

these patients has had a routine gastro-intestinal survey, including a history, physical examination, and test meal.

The period of observation has varied from two months to four years. In the majority of cases only a single series of observations has been possible; but it is planned to repeat the tests as often as practicable in the future.

FIG. 1. Common appearance in ileal stasis. Case of mild colitis (not apparent in this film). Film taken nine hours p.c.

CRITERIA AND METHODS

In the present study the following technique was adopted: A standard meal, consisting of barium sulphate in a pint of fermilac, was administered in the morning. Six hours later, an observation was made to determine whether the stomach was empty. Every case showing the slightest residue was excluded from the series. The patient was then instructed to take a mixed meal in order to encourage the discharge of the ileo-pyloric reflex. Nine hours after the ingestion of the original barium meal, another observation was made to determine whether or not the ileum was empty (Fig. 1). In accordance with our usual procedure (though not essential for the immediate purpose) the observations were continued the next morning, and each twenty-four hours thereafter until the colon was free from barium. In most cases an opaque enema completed the study.

This technique follows, in the main, that employed by previous students of ileal stasis. The chief point of difference lies in the hour set for determining the emptying time of the stomach. Hurst made his observations at three hours, Renaudeaux at 4½ hours. My use of the six hour limit may be open to the criticism that the three hours remaining would leave too short an emptying time for the small intestine. This plan was adopted simply for the purpose of utilizing as many as possible of the old cases, all of which had been run through on the six hour basis.

In order to establish an ideal technique, the following considerations are offered: The determination of the exact ileal emptying time is complicated by the fact that the latter represents the sum of two variables, namely, the emptying time of the stomach plus the emptying time of the entire small intestine. We are therefore constrained to resort to the principle of averages. The average gastric emptying time may be established at five hours, according to the Mills standard based on 1000 normals representing all types of body habitus. The average time of ileal emptying, according to Hurst, is five hours. My impression is that it may be safer to assign four hours as the interval more nearly representing the "normal" because it is possible that some cases of colitis (see below) might be included if too liberal an emptying time is adopted.

For these reasons the following technique is recommended for future studies:

1. Administer a standard barium meal at zero hour.

2. Observe gastric emptying at five hours. If the stomach is empty proceed with the schedule. If the stomach is not empty, either discard the case entirely, or else follow it through until empty and make corresponding changes in the remaining items of the program.

3. Administer a mixed meal at six hours (or at least one hour after the stomach is empty).

4. Observe the ileal emptying at nine hours (or at least 4 hours after the stomach is empty.)

Ileocecal insufficiency following the administration of an opaque enema cannot be taken as a safe criterion of ileal stasis (Table 1), inasmuch as the incidence of valvular insufficiency is the same in both stasis and non-stasis cases. Indeed these figures parallel the general incidence of 44 per cent in all my cases, an experience very comparable to that of Baetjer (50 per cent). It is moreover evident that there is nothing in these figures to support the theory (Case) that ileocecal insufficiency is a prominent cause of ileal stasis.

TABLE I

RELATION OF ILEOCECAL INSUFFICIENCY TO ILEAL STASIS

Incidence of I C I	Cases	Per Cent
In 145 cases of the "9-hour series" studied by opaque enema (general incidence)	64	44
In 88 STASIS cases	39	44
In 57 non-stasis cases	25	44
In 78 colitis cases (for comparison)	36	46

INCIDENCE (TABLE II)

General. Stasis occurred 100 times in 161 cases, an incidence of 62 per cent.

Sex. This exerts no apparent influence as 54 per cent of the positive (stasis) and 53 per cent of the negative (non-stasis) cases were males. Conversely 65 per cent of the males and 60 per cent of the females showed ileal stasis.

Age. This exerts no apparent influence as shown by distributing both positive and negative cases into groups for each decade. Most patients were in the fourth decade (ages 31–40); there were 2 each in the first and the eighth decades of life.

Gastric Acidity. Generally speaking, this exerts no marked effect on ileal stasis. However a point of some interest will be discussed later (see footnote under "colitis").

Habitus. This seems to play no rôle in stasis cases, but non-stasis is twice as common in asthenics as in sthenics. A possible explanation for this phenomenon is that low cecum is eight times more frequently encountered in slim persons than it is in stocky ones (Kantor). This is probably to be explained by the fact that ileal stasis is *relatively* uncommon in the presence of a low cecum (see below).

TABLE II

INCIDENCE OF ILEAL STASIS

General Incidence

Total cases studied ("9-hour series")	161
ILEAL STASIS found in	100 or 62 per cent
No stasis found in	61 or 38 per cent

Sex Distribution

	Males (Per Cent)	Females (Per Cent)
ILEAL STASIS	54	46
Non-stasis	53	47

Distribution as to Habitus

	Asthenics (Per Cent)	Intermediates (Per Cent)	Sthenics (Per Cent)
ILEAL STASIS	29	42	29
Non-stasis	35	48	17
Low cecum (for comparison)	54	39	7

RELATION OF ILEAL STASIS TO CONGENITAL ANOMALIES OF THE COLON (TABLE III)

There is a striking relation between the incidence of ileal stasis and the position of the cecum, or in other words, the length of the ceco-colon. In low ceca, stasis occurred in 45 per cent, an incidence distinctly lower than that in all cases (62 per cent). On the other hand, the incidence in high cecum (or congenital non-descent of the cecum) was 91 per cent, or practically twice as great as in low cecum. The series of 12 non-descent cases—a relatively rare anomaly—is admittedly small, and subsequent experience may modify these figures; yet as stasis occurred in all instances but one, this finding must have significance. The conclusion thus seems inevitable that ileal stasis occurs in inverse ratio to the degree of descent of the cecum (length of the ceco-

colon). In other words, the lower the cecum, the less the stasis; the higher the cecum, the greater the stasis (Figs. 2 and 3). Thus the terminal ileum seems, vicariously, to assume the storage function of the proximal colon whenever the latter is reduced or absent as in non-descent of the cecum.

As far as I know, this general law—if such it be—has not previously been formulated in its entirety, though to be sure, Jordan has very definitely described the association of ileal stasis with high cecum. As usual, however, he gives a purely mechanistic explanation, namely, that the stasis is caused by the retroperitoneal placement of the terminal ileum in these cases.

FIG. 2. Non-stasis in low cecum. Film taken nine hours p.c.

FIG. 3. Ileal stasis in high cecum (non-descent). Film taken nine hours p.c.

RELATION OF ILEAL STASIS TO CONSTIPATION (TABLE IV)

Even the briefest experience with the roentgen study of constipated patients will serve to recall many instances where the initial filling of the colon was surprisingly well advanced at the sixth or ninth hour after the administration of the barium meal, as though the alimentary canal, anticipating a delay, was anxious to give the fecal column a "head start." It will likewise be recalled that subsequent observation in these cases showed that the stasis was chiefly in the *distal* colon. This being the case, it is perhaps not so surprising to find that ileal stasis is far from being the rule in simple constipation. In other words, constipation cannot be regarded as a "cause" of ileal stasis. Not only is the incidence of ileal stasis in constipation (54 per cent) somewhat less than the general incidence (62 per cent), but the incidence of constipation in stasis cases is 45 per cent, which is appreciably smaller than that (60 per cent) in non-stasis cases. It is to be observed, however, that when the constipation reaches a maximum degree, as in redundant colon, the incidence of ileal stasis mounts in proportion. This is probably due to the influence of a superimposed colitis in these long-standing congenital cases.

When, however, we consider retention in the proximal colon as exemplified by cecal

TABLE III

RELATION OF COLONIC ANOMALIES TO ILEAL STASIS

Anomaly	100 STASIS cases (Per Cent)	61 Non-stasis cases (Per Cent)	General Incidence (Per Cent)
Low cecum	17	38	18
Redundant colon	20	18	14
High cecum	11	2	3

In 39 Low Ceca	Cases	Per Cent
ILEAL STASIS occurred	17	43
Non-stasis occurred	22	56
In 31 Redundant Colons		
ILEAL STASIS occurred	20	64
Non-stasis occurred	11	35
In 12 High Ceca		
ILEAL STASIS occurred	11	91
Non-stasis occurred	1	8

TABLE IV

RELATION OF CONSTIPATION TO ILEAL STASIS

Incidence of Constipation	Cases	Per Cent
In 161 cases of the "9-hour series" (general incidence)	83	51
In 100 STASIS cases	45	45
In 61 non-stasis cases	37	60
In 83 Constipated Patients		
ILEAL STASIS occurred	45	54
Non-stasis occurred	38	45

TABLE V

RELATION OF CECAL STASIS TO ILEAL STASIS

Incidence of Cecal Stasis	Cases	Per Cent
In 93 ILEAL STASIS cases	24	25
In 59 non-stasis cases	13	22
In 81 colitis cases	21	25
In 192 unselected cases	58	30
In 37 Cecal Stasis Cases		
ILEAL STASIS occurred	24	65
Non-stasis occurred	13	35

stasis, we are dealing with an entirely different proposition (Table v). As a matter of fact, the clinical significance of cecal stasis is probably quite different from that of ordinary constipation, which, as has been stated, is essentially a distal colon condition. Lack of space prevents a fuller discussion of this topic in the present paper. Suffice it here to point out that our figures support the view that cecal stasis seems to be a causative factor in the production of ileal stasis, the latter occurring in about two-thirds of the cases showing cecal retention.

RELATION OF ILEAL STASIS TO SO-CALLED CHRONIC APPENDICITIS (TABLE VI)

There seems no reason to doubt that ileal stasis is causally associated with acute inflammation of the appendix (Hurst). On the other hand, to argue by analogy that the same thing holds true for chronic appendicitis, as was done ten years ago, meets with the immediate objection that our views concerning the latter condition have undergone a material change in the past decade. Indeed the opinion is steadily gaining ground that the very term "chronic appendicitis" might best be discarded on the ground that the concept is far too indefinite to be clinically useful. We are realizing more clearly than ever before that pain in the right lower quadrant may be referable to general colonic factors such as a low cecum or cecum mobile, a distal colon spasm or obstruction with back-fire into the proximal colon, or finally, a colitis. Not only do I agree with Renaudeaux that a previous appendectomy "is common in the antecedents of ileal stasis cases," but my figures clearly show that stasis is just as common in appendectomized individuals (63 per cent) as it is in the general run of patients (62 per cent), and is, if anything, commoner than in the non-appendectomized (61 per cent). In other words, whether or not we accept the concept of chronic appendicitis as a clinical entity, it is certainly futile to remove the appendix in the hope of relieving the stasis in the ileum. The same conclusion has been reached by others, most recently perhaps, by White. This, it seems to me, is one of the strongest possible arguments for the view that in all

such cases it is far more rational to shift our attention from the appendix, as a minute thing, to the colon as a whole and to consider more and more seriously in the future, the general proposition of colon malfunction and the problem of its restoration to normal.

TABLE VI
RELATION OF APPENDECTOMY TO ILEAL STASIS

Incidence of Appendectomy	Cases	Per Cent
In 100 STASIS cases	17	17
In 61 non-stasis cases	10	16
In 88 colitis cases	17	19
In 1500 consecutive office cases (general incidence)	188	12
In 27 Appendectomized Subjects		
ILEAL STASIS occurred	17	63
Non-stasis occurred	10	37
In 134 Non-appendectomized Subjects		
ILEAL STASIS occurred	83	61
Non-stasis occurred	51	38

ILEAL STASIS AND MECHANICAL OBSTRUCTION

In the series of 100 positive cases of ileal stasis, there was no reason to suspect organic obstruction in more than two. The first was a localized postoperative infection following appendectomy. The second was a peritonitis following a parametritis.

It will be recalled in this connection that Lane and his followers originally held that many, if not most, cases of ileal stasis were caused by a kink in the terminal ileum. This view, however, has been very definitely challenged by subsequent investigators. Thus Hurst does not believe that kinks cause delay in ileal transit; and Case in his rich experience has found numerous instances of kinks and adhesions of the terminal ileum without stasis, as well as stasis without kinks. Furthermore, Renaudeaux points out that even in cases of out and out intestinal obstruction due to mechanical factors operating in the ileocecal region, ileal stasis may at times be conspicuous by its absence. Finally, my observations (see below) lead me to think that ileal stasis may be best regarded as a transient or recurrent phenomenon, depending on the state of irritability of the colon more than on any other single factor.

It, therefore, seems fair to conclude from the above that although mechanical factors may undoubtedly produce ileal stasis, they cannot be regarded as a significant cause for this condition in everyday experience.

ILEAL STASIS AND COLITIS (TABLE VII)

The association of ileal stasis with colitis is one of the most striking features brought out by this study. It is indeed surprising that this point has not been previously stressed in the literature. Before elaborating further, however, it may be well to review our present concept of colitis. Colitis is essentially an irritable state of the colon. The emphasis is nowadays placed more on malfunction than on infection, although the latter is often enough superimposed in the clinical picture. The state of colitis is expressed primarily in the character of the stools. These are generally unformed because of insufficient water extraction on the part of the "hypermotile" proximal colon, and contain an excess of mucus due to irritation of the lining membrane. Where actual bowel wall destruction takes place as in the advanced organic colitides, pus, blood, and specific infective organisms may be present. What should be particularly emphasized, however, is the commonness of the simple form—54 per cent of all patients in my practice—and the functional nature of the condition.

TABLE VII
RELATION OF COLITIS ILEAL STASIS

Incidence of Colitis	Cases	Per Cent
In 161 cases of the "9-hour series" (general incidence)	88	54
In 100 STASIS cases	68	68
In 61 non-stasis cases	22	36
In 88 Colitis Cases		
ILEAL STASIS occurred	68	77
Non-stasis occurred	20	23

The clinical symptoms of colitis are:

1. Irregular bowel action with stools varying in daily number and in consistency from mushy to hard and lumpy.

Fig. 4. Ileal stasis in severe colitis. A. Ileum. B. Transverse colon showing loss of haustrations. Film taken nine hours p.c.

2. Difficulty with gas elimination manifested by flatulence and distention.

3. Spasmodic pains along the course of the large intestine, localized chiefly in the epigastrium and often occurring immediately after meals, owing to the increased colonic activity at that time.

Roentgenographically, colitis gives characteristic findings (Fig. 4). Unfortunately, these are not as well known as they should be. It is intended to elaborate this matter in a future communication. For the present, it may suffice to present somewhat arbitrarily the following list of roentgen findings as being suggestive, if not actually diagnostic, of colitis:

1. At the "6-hour observation" the head of the barium column lies beyond the splenic flexure.

2. At the "9-hour observation" the head of the column lies in the pelvic colon; or else a complete circuit of the colon has been achieved with or without a bowel movement.

3. At the "24-hour observation" the colon is empty.

Fig. 5a.

Fig. 5b.

Figs. 5a and b. Two films, three weeks apart, in the same individual, showing disappearance of ileal stasis concomitant with diminution in irritability of colon. 5a. Note ileal stasis, atypical haustrations of transverse colon, and heavy filling of distal colon. 5b. Note nonstasis in ileum, normal haustra in transverse colon and faint filling of distal colon.

4. Loss or irregularity of haustrations or mottling or "feathering" of fecal column.
5. Scattered filling of colon or filling defect not due to new growth.
6. Increased gas content of colon.

To which may be added:

7. At the "6-hour observation" no barium beyond ileocecal junction.
8. At the "9-hour observation" ileal stasis.

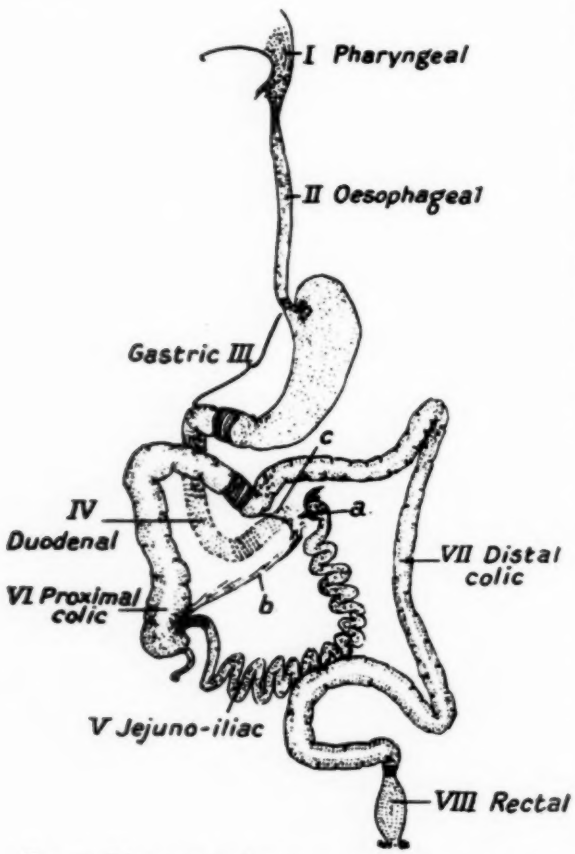

FIG. 6. Diagram of alimentary tract showing neuromuscular sections (after Keith).

Of the 84 cases in the colitis group, 2 were tuberculous, 7 were ulcerative, 1 was carcinomatous, in nature. About 15 were clinically characterized by continuous diarrheas. The rest had, at most, occasional mushy stools, generally overlooked by the patients, and the diagnosis was frequently entirely missed in their past medical history.

Returning now to the relation of colitis to ileal stasis, it was found not only that colitis occurred in about two-thirds of all stasis cases, but what is still more significant, that ileal stasis occurred in more than three-fourths of the patients with colitis.* Moreover it was definitely observed in one instance that with diminution in the irritability of the colon, there was a concomitant disappearance of the stasis in the small intestine (Figs. 5*a* and 5*b*). In other words, judging from the best available evidence, it appears reasonable to conclude *that colitis is causally related to ileal stasis.*

How can this relationship be best explained? It seems to me that one must look to the physiology of the ileocecal region for the solution. Keith and Alvarez have both likened the alimentary tract to "a railroad divided into sections (Fig. 6), each provided with its signalman and telephonic apparatus. The signalman of one section refuses to accept any more traffic until this section is clear; all sections are closely correlated; if one is blocked, the others too become automatically blocked. Disturbance in one section upsets the traffic in all" (Keith).

This hypothesis fits in beautifully with our proposition that colitis is a prominent, if not the most prominent, clinical cause of ileal stasis. If our observations mean anything, they would seem to mean that just as the irritable colon fails to hold its contents long enough for proper dehydration (colonic hypermotility), so it fails to accept willingly the entrance of new material from the small intestine (ileal stasis). In other words, we are apparently dealing with a state of lowered receptivity coincident with an increased colonic irritability. In this way, ileal stasis may be rationally explained as a reaction of defense for the protection of an injured segment of the intestinal pathway. This reaction is medil ated through the mechanism of the ileocecaapparatus. The more precise evaluation of this mechanism in terms of sphincter spasm, nodal point conductivity, or gradients of irritability lies rather in the province of the experimental physiologist than in that of the practising clinician.

* Those colitis cases which did not show ileal stasis may be explained in part by the intestinal hypermotility commonly associated with gastric anacidity. Thus, the incidence of achlorhydria was found to be four times as common in colitis without stasis as in colitis with stasis. Even this consideration, however, leaves about 17 per cent of this group of cases without adequate explanation on the theory here presented.

SUMMARY AND CONCLUSIONS (TABLE VIII)

1. Ileal emptying (the ileocecal transit) was studied after the administration of a barium meal in 161 cases.

2. Ileal stasis occurs in over three-fifths of all patients.

3. Ileal stasis does not seem to be so directly associated with constipation in general as it is with cecal stasis in particular.

4. Ileal stasis is not commonly associated with obstruction due to mechanical factors.

5. Ileal stasis seems to vary inversely with the degree of descent of the cecum (length of the ceco-colon).

6. Ileal stasis seems definitely associated with a state of *lowered receptivity* of the colon as indicated by *increased irritability* and expressed clinically by the presence of *colitis*.

7. Ileal stasis is therefore best explained as a functional defense reaction for the protection of an injured segment of the intestinal pathway. It may thus be transient or recurrent as well as continuous in its operation.

8. This study seems to support the block system control theory of gastrointestinal motor function.

TABLE VIII

SYNOPTIC REVIEW OF SIGNIFICANT FACTORS IN ILEAL STASIS

Incidence of ILEAL STASIS	Per Cent
In low cecum	45
In constipation	54
In all cases (general incidence)	62
In redundant colon	64
In colitis	77
In high cecum (Note: Only 12 cases!)	91

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THE ETIOLOGY AND TREATMENT OF CHRONIC ULCERATIVE COLITIS*

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CHRONIC ulcerative colitis is an inflammatory disease of the colon. It has received various designations, such as nonspecific, idiopathic, postbacillary, infectious, and septic ulcerative colitis. Clearly its many names have pointed to lack of knowledge of its etiology.

Before the use of the sigmoidoscope the disease was diagnosed only at necropsy. Early descriptions of the condition as a disease entity date back to Wilks and Moxon in 1875, and to White in 1888. The literature on this subject for the half century from 1875 to 1925 abounds in descriptions of the clinical picture of this disease which agree closely enough to identify a definite group of symptoms, proctoscopic and roentgen-ray findings as characteristic of chronic ulcerative colitis.

The fact that nearly every group of men with experience in handling the disease considered different causative factors as basic is another indication of the uncertainty of its etiology. Logan and his coworkers considered some metabolic disturbance as etiologic. Hurst, Einhorn, Leusden, Thorlakson, and others, considered dysentery bacilli the original invaders, and attributed the fact that these organisms were not found in the stools to secondary invaders. Bassler considered an increased virulence of the colon bacillus of paramount importance, and his belief is shared by most German writers on the subject. Other workers thought the colonic ulceration was a postamebic residue. Nearly every bacterium of any pathogenic significance inhabiting the colon has received its share of blame. That streptococci have received their just portion of this is evidenced by the fact that such a formidable array of men as Jex-Blake, White, Yeomans, Wallis, Hewes, Lockhart Mummery, Rolleston (Thorlakson), and Brown have considered them of etiologic significance. Finally, most authors have ascribed the disease to what they believed was a pneumococcus. White says, "I have met with cases due to B. coli and some to pneumococci." Brown reports the finding of "an almost pure culture of an anaerobic diplococcus" in one case and a "streptococcus with diplococcal arrangement" in another. Thorlakson found "diplococci resembling the pneumococcus in almost pure culture" in one case.

At the Mayo Clinic the ages of patients with chronic ulcerative colitis have ranged from three to seventy-three years. However, in our series of approximately 600 patients the disease was most common in the second and third decade.

The symptoms of the disease are briefly those of either acute, or long-standing, extensive, colonic ulceration, i.e., continuous or intermittent, intractable diarrhea with bloody mucopurulent rectal discharges, general malaise, frequently pain and tenesmus, anemia, mild leucocytosis, occasional fever, and general wasting. The onset is usually insidious, although it may be sudden.

Its pathology is best explained by the insidious onset. Early there are edema and hyperemia of the mucous membrane. Miliary abscesses develop, which slough and form minute ulcers. By their coalescing and the pressure resulting from necrosis of surrounding tissues, irreglar shaggy ulcers form. Repeated exacerbations of this kind or continuous reinfection best account for the later picture.

Arthritis is a frequent complication; it occurred in 8 to 10 per cent of our series. Exacerbations of the rheumatism occur as the colitis progresses. Perianal infections, abscesses, fistulas, and sinuses are among the most dreaded of the accompanying conditions. Malignant disease is occasionally superimposed on the colitis. Hemorrhage due to perforation of blood vessels by ulcers is rare, but continuous

* Read at the Twenty-seventh Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Detroit, Mich., May 17–21, 1926.

bleeding with exhaustion of the blood-forming organs, to the point that they are unable to keep pace with the blood lost, occurs frequently. Visceral degeneration with amyloid change in the organs occurs late in the disease. Inanition or peritonitis sometimes causes death. The bowel becomes so friable that at times it is perforated and the intestinal contents spill into the abdomen, and because of the patient's low vitality no peritonitis or any inflammatory reaction may result.

Through the proctoscope one sees many stages of the ulcerative process. No better description of the proctoscopic picture exists than that described by Buie. The granular, easily bleeding, diffusely edematous and hyperemic mucous membrane constitutes the usual early and characteristic picture. This is followed by various gradations of ulceration. There may be only the extremely hemorrhagic mucous membrane with its "snow storm" of miliary abscesses, or the granular, glazed mucosa, or irregular, confluent ulcerations with only tufts of mucosa here and there. Small polypous overgrowths of mucous membrane are occasionally scattered throughout the region of inflammation. Later appear "the footprints," as Buie designates the residue, of the healing and scarred mucosa.

Our recent experimental work has led us to formulate two conceptions of this disease, and there can be no doubt that chronic ulcerative colitis is a disease entity: (1) the disease is of infectious origin, and (2) the infection is conveyed by repeated "showers" of bacteria being thrown into the circulation by a distant focus. The clinical story, the proctoscopic and roentgen-ray pictures, the gross and microscopic appearance, many of the complications, and the experimental evidence substantiate these hypotheses most convincingly.

A Gram-positive, lancet-shaped diplococcus (Fig. 1), which has been isolated in the vast majority of cases of chronic ulcerative colitis has previously been described. If searched for at the proper time I believe this organism would be found in all cases of this disease. The microorganism is best isolated through the proctoscope, from the scrapings and swabbings of the ulcers after thoroughly cleansing the surrounding mucosa. It grows well under anaerobic, or partially anaerobic conditions, in such a medium as Rosenow's dextrose brain broth, and appears in characteristic colonies on blood-agar plates. It seems to have distinctive sugar fermentation reactions. Its morphology resembles that of the pneumococcus, which fact may explain why the organism was previously considered a pneumococcus. However, it is not bile soluble and is not agglutinated by pneumococcus serums.

The serum of horses, immunized by the method used by Rosenow, that is, by injecting intravenously suspensions of

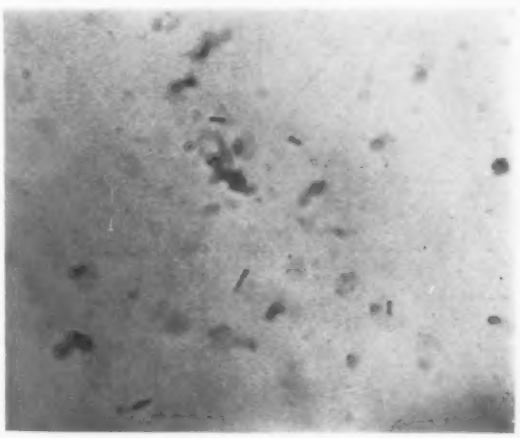

FIG. 1. Diplococcus isolated from a lesion of the rectum.

freshly isolated strains whose specificity is preserved in dense suspension in glycerin (2 parts) and 25 per cent sodium chlorid solution (1 part), agglutinates heterogeneous strains and causes precipitation with filtrates of freshly isolated cultures.

Pure cultures of the organism injected intravenously have produced lesions essentially like those in human beings in several hundred rabbits and in a very high percentage of dogs (11 out of 15). The diplococcus has been reisolated from the heart's blood and mesenteric lymph nodes of dogs and rabbits injected with cultures of the organism when they died from the disease. Cultures of the microorganism so isolated have again produced similar lesions when they were reinjected. In rabbits the lesions

have been of the acute fulminating type (Fig. 2), which killed the animals in from twenty-four hours to several days.

By injecting intravenously into dogs repeated graduated doses of the whole culture or fresh suspensions in sodium chlorid, lesions, identical in all essentials to the lesions in the later stages of chronic ulcerative colitis in human beings, have been produced: an ulcerated mucosa, a thickened "grisly" colon wall with thickened muscularis and submucosa, and the mucosa absent here and there. Animals have been given daily increasing doses of diplococci intravenously for as long as three weeks. Passage of blood and other signs of colon disease usually began within a week after the initial injection (Figs. 3, 4 and 5).

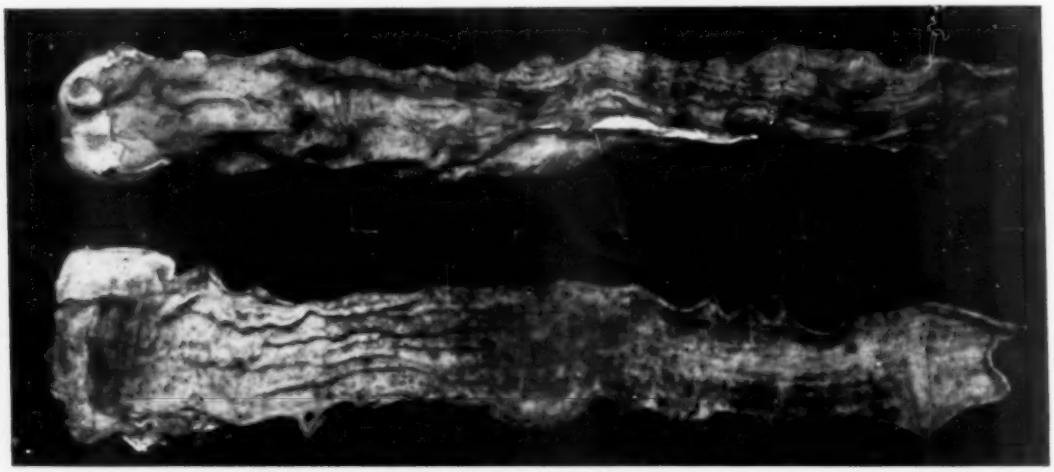

FIG. 2. Lower ends of colons of two rabbits; lesions produced by the intravenous injection of diplococci isolated from the rectal lesions of patients.

Clinical results and experimental evidence strongly suggest that distant foci of infection play a prominent rôle in the etiology of this disease. We have repeatedly seen acute exacerbations of bloody diarrhea after the removal of septic tonsils or peri-apically infected teeth which subsided with the healing of the abrasion made where the focus was removed. Furthermore, a lancet-shaped diplococcus morphologically like the organism isolated from rectal lesions has been found repeatedly in cultures of such foci, at times in pure culture. At least a dozen strains of the diplococcus isolated from distant foci (Fig. 6), when injected intravenously into rabbits, have produced colon lesions essentially like those of acute ulcerative colitis of human beings. In one

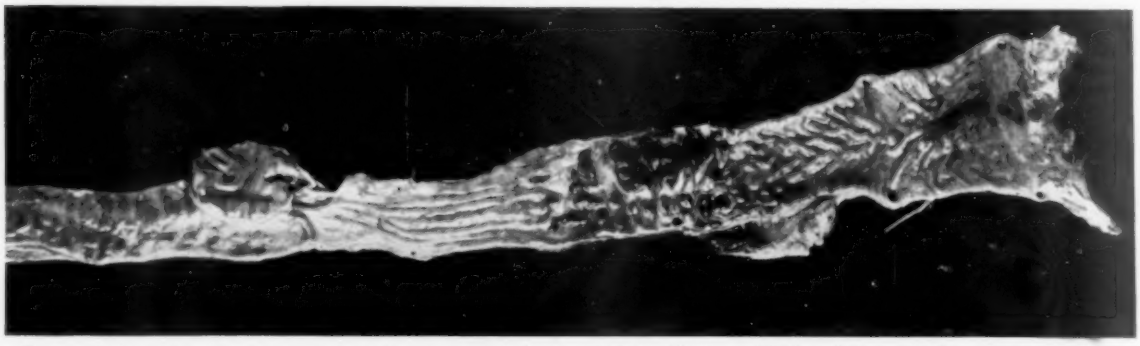

FIG. 3. Colon of a dog after repeated intravenous injections of the diplococci isolated from the lesions of a patient with ulcerative colitis.

patient a suppurative cholecystitis was seemingly the focus.

Ulceration of the colon has been seen in its earliest stages in several persons in whom ileostomy or colostomy had been performed. The various stages of the disease process were observed in these cases, the hyperemia and edema of the mucosa, the appearance of minute abscesses on the two exposed loops of bowel, sloughing of

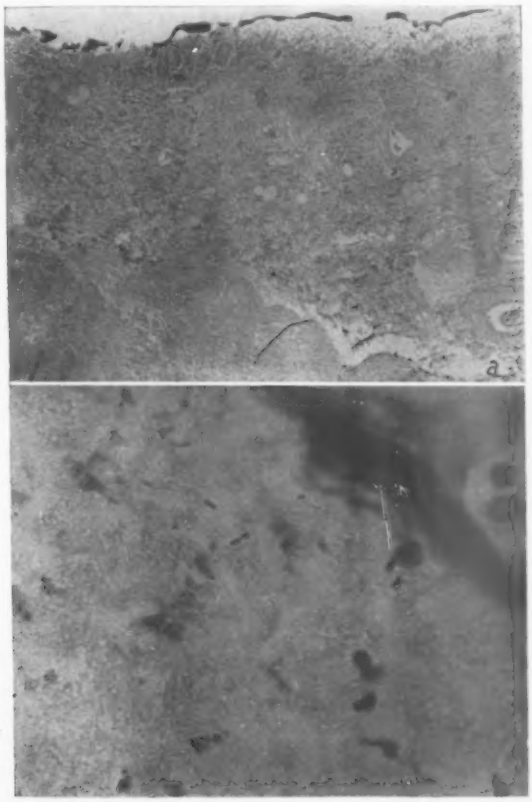

FIG. 4.(*a*) Section of colon from patient with chronic ulcerative colitis (× 40); (*b*) diplococci in depth of section (×1000).

the abscesses with minute ulceration, the granular appearance, and finally because of their numbers, gradual confluence of the ulcers forming the typical picture seen proctoscopically. From such miliary abscesses a pure culture of the diplococcus has been isolated.

The treatment of chronic ulcerative colitis has been even more varied than its many theories of etiology. Careful dietary restriction has always found favor, since reasonably bland, high-protein or non-residue diets allay the diarrhea. Medicaments to inhibit intestinal peristalsis have been used freely, including opium, and bismuth. Blood tonics such as Blaud's, Fowler's solution, and cod-liver oil have had their claims.

Local and topical applications and irrigations of one kind or another have always been advocated, being used as so-called intestinal antiseptics. Those which have

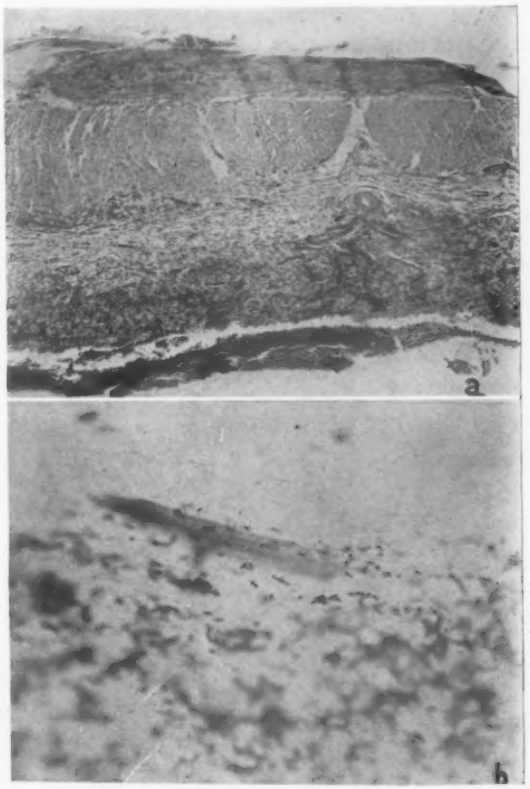

FIG. 5.(*a*) Section of specimen shown in Figure 3 (×40); (*b*) diplococci in section (×1000).

received the greatest acclaim are argyrol, silver nitrate, mercurochrome, tannic acid and acriflavin. With the latter, Crohn and Rosenberg of New York, in 1923, produced at least 6 apparent cures in a series of 14 patients. Bismuth in olive oil and witch hazel, as instillations, have been found to allay irritation.

Nonspecific vaccine therapy has had its advocates, especially among German writers. In February, 1926, Grossfeld advocated the use of vaccine prepared from the predominating flora of the colon but

also noted streptococci and Friedländer's bacillus. Vaccines prepared from *Bacillus dysenteriae* have been used by Leusden; those from colon bacilli by Bassler and others.

Surgical treatment to relieve the colon of the ileal secretions and divert the bowel matter, as well as for irrigation, even an operation associated with as much risk as a colectomy, has had, and still has, its advocates. Cecostomy, appendicostomy, ileostomy and ileosigmoidostomy have been the operations of choice, the Brown ileostomy or some modification of it predominating.

I mention those treatments which in the hands of various workers have given some measure of success only to introduce what we feel is a more rational form of treatment. That the diplococcus described is of etiologic significance seems unchallenged. The treatment then consists primarily in immunization against this organism. The subcutaneous administration of vaccines and vaccine-filtrates from the diplococcus prepared by the methods of Rosenow forms the main portion of the treatment. Our present efforts are directed toward the preparation of a serum which should hold some promise. An important step in the treatment is the removal of all distant foci of infection, including tonsils and teeth, as these are the only offenders of known etiologic significance. It is advisable to remove these foci before beginning vaccine therapy. Diet is important only as a supporting agent during the active stage of the disease. This should consist of bland, non-irritating foods.

The empirical administration of such drugs as tincture of iodin, kaolin and bismuth by mouth have value in some cases. Local and topical applications are useful in selected cases. Water between 115° and 120° F. seems to have about as much efficacy as the so-called intestinal antiseptics.

Ileostomy is only an extreme measure. Of 178 patients treated according to our present methods only 7 have come to surgery in the last two years. Seventy-eight of the 178 patients at this time have been clinically well for from several months to as long as two years; at least there have been long remissions of the disease. Fifty-six are still under treatment. Six have died; 2 from peritonitis, 2 from carcinoma superimposed on the colitis, one from inanition, and one from lymphatic leucemia. Four are known to have received no benefit and the rest have not been heard from for a number of months and it seems reasonable that some of the latter are well.

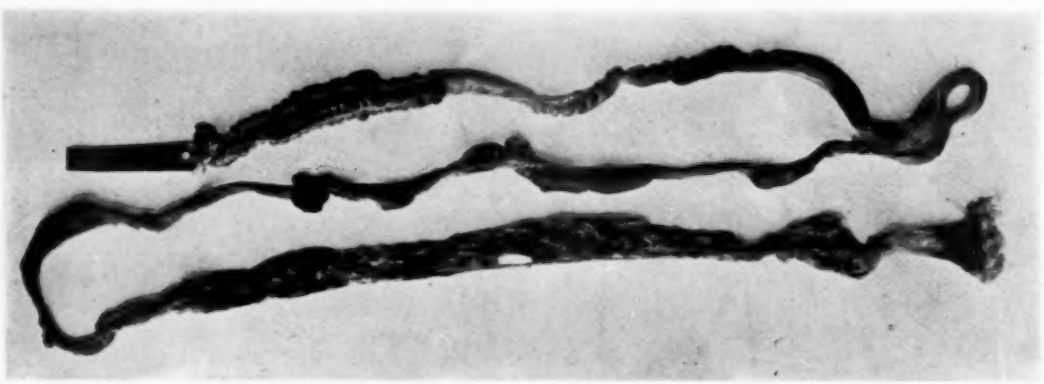

FIG. 6. Colon of a rabbit after the intravenous injection of diplococci isolated from a periapical abscess of a tooth of a patient with ulcerative colitis.

The experimental evidence and the results with specific treatment establish the etiologic significance of the diplococcus described and suggest methods to combat its invasion and to eliminate it as the treatment of choice.

REPORT OF CASES

CASE 1. A boy, aged nine, first came to the Mayo Clinic in 1915 with a history of diarrhea for a year or longer. At that time there were

five to six movements a day with much blood, some mucus and pus. He lived only twenty miles from Rochester and visited the Clinic during the following ten years whenever his trouble became very severe, which was at least several times a year. When he first came he was placed on an antiamebic regimen which at that time consisted of emetin hydrochloride hypodermically and coal-oil irrigations. Repeated stool tests at that time revealed no amebae or parasites of any kind. By proctoscope, a diagnosis of colitis was made.

Each successive "cold" caused a flare-up of the colitis, and he had colds and tonsillitis at all seasons of the year. Finally in July, 1924, he was brought to the Clinic in an exhausted condition with severe bronchitis and had to be taken to the hospital at once. He made the statement then that as long as he could remember he had never passed fewer than six or eight stools in twenty-four hours, and they were always mixed with blood. For weeks after a cold he would pass from fifteen to twenty-five stools in twenty-four hours, with severe cramps and tenesmus before and with each passage. At this visit successive stool tests for entameba and acid-fast bacilli were again negative, but by culture of the scrapings from the bases of the ulcers a great predominance of Gram-positive diplococci was found. At this time he had a low-grade fever, and the maximal leucocyte count was 19,300.

The proctoscope revealed very active ulcerative colitis of Grade 4.

The roentgen examination of the colon revealed that it was foreshortened and tube-like, a condition typical of the so-called idiopathic ulcerative colitis. The patient had the pasty appearance of a person with visceral degeneration. His weight, which at the maximum had been 135, was now 120 pounds.

He recovered slowly from his bronchitis, and by palliative measures his stools were gradually reduced in number. About that time he developed a perirectal abscess burrowing under the sphincter. From the pus of this abscess a pure culture of the diplococcus was recovered.

From then on, October, 1924, his treatment consisted of autogenous vaccine, tincture of iodin at intervals by mouth and local medication in an effort to clean up the perirectal pus pocket. The latter was continued at intervals until March, 1925.

The patient has steadily improved. In August, 1925, and again in October, he came back, proctoscopically and clinically entirely well. A roentgenogram of the colon taken in August shows some persistent contraction but a partial return of haustrations. His weight is now 153 pounds. He feels well and is doing a full man's work at nineteen, whereas he never worked before.

Case II. A man, aged thirty-two, a farmer from Wisconsin, was brought to the Clinic April 6, 1925, in an ambulance. He was passing from twenty to twenty-five bloody stools in twenty-four hours, accompanied with terrific cramps, tenesmus, and rectal spasm.

His trouble began a year before with a gradually increasing number of bowel movements. He first noticed blood six months before coming here when he passed eight to ten stools in twenty-four hours.

On admission to the hospital the roentgen examination revealed a lesion of the entire colon, and by proctoscope granular proctosigmoiditis with the mucosa covered with dirty exudate was discovered. Repeated stool tests failed to reveal entameba or other parasites, but a marked predominance of Gram-positive diplococci was found by culturing scrapings from the lesions. The hemoglobin was 50 per cent. The temperature was 98.8° F. and the pulse rate 110. He had lost 15 pounds in weight during the month previous to his admission.

He was given small doses of kaolin and tincture of iodin by mouth and, as soon as the vaccine-filtrate was prepared, was given subcutaneous injections of this. The latter were continued for several months. During his first stay at the Clinic, several septic teeth were removed.

In August, five months after the first admission, he returned and was well clinically, proctoscopically, and roentgenologically. The bowel which at first was a stiff tube, had even regained its haustrations. He was passing one or two formed stools daily and his weight was 30 pounds more than on his first admission.

Last month he reported that he was still well and had gained 5 pounds more.

Case III. A man, aged thirty-five, a stock raiser, was taken ill rather suddenly six weeks before coming to the Clinic last May; he had severe abdominal cramps and a few days later passed mucus and blood. When he came to the Clinic he was passing fifteen bloody stools in twenty-four hours and his weight had been reduced from 180 to 145 pounds in a month.

The proctoscope revealed an edematous, markedly inflamed, easily bleeding, granular mucous membrane with small disseminated ulcers. The roentgen ray revealed an acute lesion of the entire colon. A roentgen examination of his chest was negative. Two teeth revealed periapical infection. A pure culture of Gram-positive diplococci was recovered from some of the granules of the rectal mucosa and from this a vaccine-filtrate prepared.

He was given tincture of iodin by mouth and vaccine-filtrate subcutaneously. One-tenth of a cubic centimeter of vaccine-filtrate caused a severe bowel upset with a watery bloody stool every hour during the first twenty-four hours, fewer the next twenty-four hours, and only six stools the third twenty-four hours.

With 0.2 c.c. the same reaction followed and on the third day, only four stools were passed in twenty-four hours.

From then on, a week after the beginning of treatment, improvement continued and when he reported in August and again in October, he was entirely well, clinically, proctoscopically and by roentgen examination, and had regained his normal weight.

His tonsils and infected teeth were removed.

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VOL. XVI, NO. 1

THE ROENTGENOLOGIC FINDINGS IN ULCERATIVE COLITIS*

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BY chronic ulcerative colitis is meant that form of colonic ulceration which is not caused by infestation with parasites, tuberculosis, dysentery, actinomycosis or syphilis. While long recognized as a distinct pathologic entity, only in the last few decades has much progress been made in its diagnosis or treatment. Chronic ulcerative colitis is by no means uncommon. Logan has collected records of about 600 cases which have been seen at the Mayo Clinic, and clinical and necropsy records contain many references to this disease. The differentiation of the chronic ulcerative from other forms of colitis is not always easy. However, a properly taken and correctly interpreted clinical history, careful examination of the stools, proctoscopy, and roentgenologic examination will usually establish the diagnosis.

While this paper primarily considers the roentgenologic signs, it may be well to emphasize briefly the other features that enter into the diagnosis. Logan describes two distinct clinical types in both of which profuse diarrhea is the chief complaint. In one of these the condition is more or less chronic, and the patients show but little systemic reaction; in the other the condition is acute and is accompanied by extreme prostration. The stools are profuse and watery and contain much blood and mucus. The microscopic examination is important in excluding parasites and other specific organisms. The proctoscope which satisfactorily exposes the lower 25 to 30 cm. of the large bowel for inspection is a most important means of diagnosis. Areas of ulceration which begin in the rectum and extend upward are very characteristic, and these are easily recognized by the proctoscopist.

The etiology of chronic ulcerative colitis has been so thoroughly discussed in Bargen's paper[1] that it is unnecessary to allude to it other than to say that his work has resulted in a much more rational understanding of its clinical manifestations and has accomplished a great deal in its treatment.

The roentgenologic findings in chronic ulcerative colitis are explained by an understanding of the pathologic changes found in the wall of the large bowel. Hale White, in his original article published in 1888, first described the pathology of this disease, and since that time little has been added to our knowledge. The process begins in the rectum as small superficial multiple ulcers, which in the early stages involve only the mucosa. These ulcers alternately heal and break down, and gradually extend upward until the entire large bowel is involved. Rarely, if ever, does the process extend beyond the ileocecal valve. The stage of superficial ulceration is followed by a deeper penetration of the intestinal coats, with round-cell infiltration, abscess formation and resulting fibrosis which greatly thickens the walls of the bowel and reduces the size of its lumen. In advanced cases this reduction is so great as practically to obliterate the lumen.

In our experience, the roentgenologic examination in cases of suspected chronic ulcerative colitis is best accomplished by the barium enema. The ingested meal merely shows rapid emptying, as in all conditions accompanied by diarrhea, without giving a satisfactory idea of the size or condition of the bowel. For the enema a fairly fluid suspension of barium is used and is injected slowly under roentgenoscopic control, careful search being made for any evidence of spasm, irregularities or encroachments on the lumen of the bowel. In fact, the behavior of the bowel as the column of barium ascends often gives the first evidence of the presence of a lesion. A sufficient amount is injected to fill the bowel, care being exercised not to over-distend it or cause undue discomfort.

[1] See preceding paper.

* Read at the Twenty-seventh Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Detroit, Mich., May 17–21, 1926.

In the early stages of chronic ulcerative colitis spasm is the chief roentgenologic manifestation; this is due to the irritation of the ulcerated bowel and, depending on the extent of the disease, may be either localized or diffuse. In this stage of the disease the roentgenologic findings will not differentiate the chronic ulcerative from other forms of colitis. However, when colonic spasm, persisting after the exhibition of belladonna, is demonstrated by the roentgen ray, and the proctoscopist discovers ulcers in the rectum which extend upward, the diagnosis is assured. As the disease advances and the wall of the bowel thickens, the typical roentgenologic signs appear. These consist in rapid filling of the entire large bowel, marked narrowing of its lumen and absence of haustration. Interspersed throughout the bowel are areas of contraction giving the appearance of a string of sausages. The rapid filling of the colon is practically always accompanied by a passage of the column of barium through the ileocecal valve into the ileum. However, this is such a common occurrence under normal conditions that no importance can be attached to it.

FIG. 1. Chronic ulcerative colitis; slight narrowing of lumen and absence of haustra.

FIG. 2. Chronic ulcerative colitis involving transverse and descending colon; marked narrowing of the lumen and absence of haustra.

The narrowed lumen and absence of haustra is of course due to thickening of the intestinal wall and gives to the large bowel the appearance of a straight tube which in advanced cases may be no larger than an ordinary lead pencil. The constricted areas are due to strictures from localized deep ulceration; the fact that they are constant in position seems to indicate that spasm does not produce them.

The roentgenologic appearance in a well-advanced case of chronic ulcerative colitis is so typical that its differentiation from other lesions of the large bowel is usually not difficult; however, it may be well to enumerate briefly the signs of the lesions which must be differentiated.

Carcinoma and syphilis both show definite filling defects with obstruction and dilatation above the lesion; the former is usually associated with a palpable mass while the latter is not. In our experience syphilitic lesions of the colon are extremely rare.

Tuberculosis is most frequently found in the cecum and ascending colon; it produces irregular filling defects accompanied by

the alternate filling and emptying that is so characteristic. Diverticulosis and diverticulitis both show the characteristic extraluminal shadows; moreover, in the latter a definite filling defect is shown. This simulates carcinoma and should never be confused with chronic ulcerative colitis.

Fig. 3. Chronic ulcerative colitis involving entire large bowel; there are numerous areas of contraction producing the typical string-of-sausages appearance.

In our experience the lesions produced by *Amoeba histolytica* and other parasites produce no abnormal roentgenologic findings. Occasionally spasm is noted but this is transitory and is no more marked than that seen at times in the normal colon.

Fig. 4. Chronic ulcerative colitis; involvement of entire large bowel with extensive areas of extreme contraction.

In certain types of chronic constipation, accompanied by extreme atony of the large bowel, the roentgenologic examination reveals a large, straight, tube-like colon with an apparent absence of haustration.

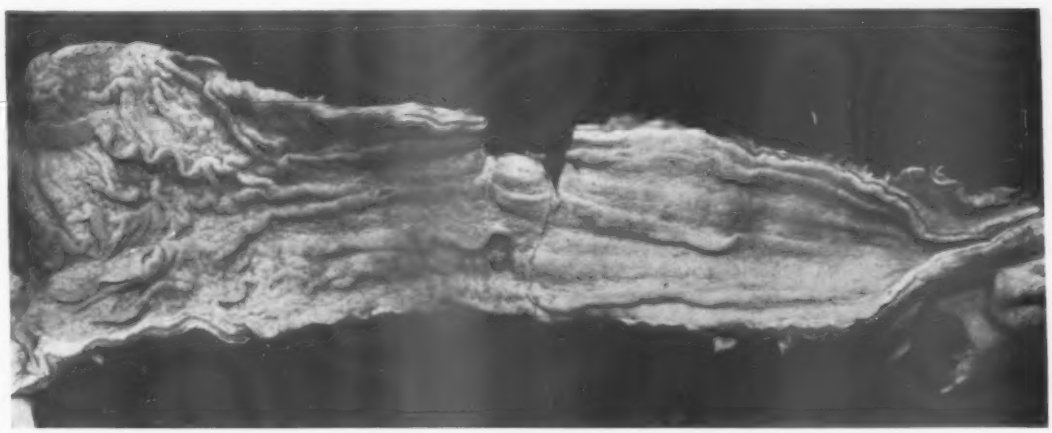

Fig. 5. Characteristic changes of chronic ulcerative colitis.

Actinomycosis is localized, usually accompanied by fistulous tracts and resembles more closely carcinoma or tuberculosis than it does any of the forms of colitis.

This has been mistaken for chronic ulcerative colitis; however, the dilatation as contrasted with the contraction of the lumen seen in chronic ulcerative colitis, the flexibility instead of rigidity of the bowel and the history of constipation rather than diarrhea should preclude this error.

In conclusion, it must be borne in mind that the roentgenologic examination furnishes but one link in the chain of evidence and must be used in collaboration with the clinical and proctoscopic findings. By this method the percentage of correct diagnoses may be made extremely high (Figs. 1 to 5).

FREIBERG'S INFRACTION OF THE METATARSAL HEAD

(KÖHLER'S METATARSOPHALANGEAL SYNDROME; JUVENILE DEFORMING METATARSOPHALANGEAL OSTECCHONDRITIS)

BY KEITH T. MEYER, M.D.

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THE following case of Freiberg's infraction of the metatarsal head (juvenile deforming metatarsophalangeal osteochondritis) is reported because of its exceeding rarity. Freiberg[1] reported 6 cases in August, 1914. He saw his first case in 1903. Lewin[2] of Chicago, reported 2 cases in 1923. Köhler[3] in September, 1923, reported having seen 4 or 5 cases. He acknowledged a total of about 75 additional cases having been reported in the literature. Additional reports of cases have undoubtedly been made since 1923, but no effort was made to review the literature.

The etiology of the condition is unknown. It occurs much more frequently in the female than in the male. The second metatarsal bone is involved in nearly all the reported cases; occasionally the third metatarsal bone is involved; and rarely are both bones involved. In nearly two-thirds of the cases it occurred between the ages of ten and eighteen years.

The pathology, microscopically, as quoted from Köhler's article, shows at times necrosis, at times fibrous marrow, at times tissue resembling granulation tissue, thickened cortex and well-preserved cartilage.

The symptomatology is pain definitely localized to the site of the affected bone, with considerable sensitiveness to pressure over the head of the involved metatarsal bone. There may be some tumefaction of the soft tissue, with no heat nor redness suggestive of localized abscess.

The diagnosis is made from the roentgenogram which reveals the following characteristic bone and joint changes: (1) broadening of the metatarsophalangeal joint space; (2) flattening of the neck and distal portion of the shaft, with the resultant disappearance of the constriction at the site of the neck; (3) bone absorption changes in the head suggestive of sequestration. In addition to these bone and joint changes, which are present in the roentgenogram of the case here reported, the articular surface of the proximal phalanx may lose its circular form and become irregular.

CASE REPORT

L. M., a white girl, aged fourteen, complained of pain in the ball of the left foot on wearing a shoe or a slipper. The duration of the pain was six weeks with no evidence of trauma or other cause. The general health had always been excellent except for an occasional sore throat.

Physical Examination. Patient large and well nourished for age. Head, chest, and abdominal examinations were all negative. Over the middle of the left foot, in the region of the second metatarsophalangeal articulation, there was a point of tenderness. No swelling nor redness. The

lymphatic glands in the left popliteal and left inguinal region were not palpable.

Laboratory Tests. The urine was found negative. The blood examination showed: red blood cells 5,000,000; white blood cells, 7,800; hemoglobin, 90 per cent. The differential count showed: neutrophiles, 64 per cent; small mononuclears, 32 per cent; large mononuclears, 4 per cent.

Roentgen Examination. Roentgenogram of the left foot, in the plantar-dorsal exposure, shows some widening of the joint space of the second metatarsophalangeal articulation, with a flattening of the articular surface of the second metatarsal bone. The distal half of the shaft of the second metatarsus is somewhat broadened. Two areas of lessened bone density, millet seed in size, can be visualized just proximal to the articular surface.

Treatment. Daily diathermic treatments, for a period of two weeks, were applied at the site of tenderness. In addition to this, the patient was restrained from walking on this foot. The pain and tenderness disappeared at the end of the first week. She was permitted to go home at the end of the second week. A letter from the patient three months later reported no return of pain or tenderness.

FIG. 1.

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THE ROENTGEN-RAY TREATMENT OF KELOID*

BY G. W. GRIER, M.D.

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A review of the literature on keloids reveals an uncommon condition in medical practice, that is, unanimity of opinion in regard to a method of treatment. It is practically universally agreed that radiation is the best form of treatment, some preferring roentgen rays, others radium. Considering the positiveness of these opinions and the number of years the treatment has been in vogue, one would think there would be agreement on a definite technique which could be relied upon to give uniform results. I have failed to find such agreement after consulting numerous text books on dermatology and radiotherapy. Some authors merely state that the lesion responds well to radiation, others recommend the use of well-filtered radiation; the majority advise the use of unfiltered radiation for small lesions and of filtered radiation for large or thick lesions.

Having tried all of the above methods at different times during the last fifteen years with very uncertain results, I have come to the conclusion that the most reliable results are obtained by the use of unfiltered radiation regardless of the size or thickness of the lesion. This statement applies only to roentgen-ray treatment as I have not used radium in enough cases to draw conclusions. The 4 cases in which I have used radium were all treated with gamma radiation through a 1 mm. brass filter. Only one of the four was benefited by this treatment. McKee states that beta radiation should be used for small lesions and gamma rays for thick lesions, while Simpson uses a plaque screened with 0.1 to 1 mm. of lead which would transmit only a small percentage of beta rays.

The accompanying table includes the cases of keloid which I have treated since 1914.

Cases are classified as cured when the elevation and induration entirely disappeared leaving only a soft pliable scar. Improved cases include those which were relieved of pain or in which the tumor became smaller or softer. The earliest cases were treated through 3 mm. aluminum filter, and if this failed a different thickness of filter was tried in an effort to fit the filter to the size and thickness of the lesion. The cases classified as being treated by a combination of filters are those which were treated in this manner. The gradual conviction that cases treated with thin filters showed the most improvement led me to the use of 1 mm. of aluminum as a filter, and finally to the omission of the filter entirely. Reference to the table will show the constant improvement in results which followed these changes in technique.

Method Used	Cases	Cured	Improved	Unimproved
3 mm. aluminum filter	7		4	3
Combination 1 mm. and 3 mm. aluminum filters	1		1	
Combination 1, 2, 3, and 4 mm. aluminum filters	1		1	3
Combination 2 and 3 mm. aluminum filters	6 2		3	2
Combination 3 and 4 mm. aluminum filters	2		1	1
1 mm. aluminum filter	7	2	4	1
1 mm. aluminum filter after heavier filtration failed	1	1		
Radium only	1			1
Radium after roentgen rays failed	3	3		2
No filter	12	10		2
No filter, after filtered radiation failed	2	2		
Total	39	16	11	12

AVERAGE NUMBER OF TREATMENTS

	Radium	No Filter	1 mm. Al	3 mm. Al	Combination
Cured cases	1	$3\frac{2}{3}$	$5\frac{1}{3}$		
Improved cases			$2\frac{3}{4}$	10	8
Unimproved cases	1	3	1	$7\frac{1}{3}$	$9\frac{1}{3}$

The recommendation that unfiltered radiation be used on small lesions and filtered radiation on large and thick ones is possibly open to the criticism that various workers may have different ideas as to what constitutes a large or a small lesion. It is also possible that all the lesions which I have treated with unfiltered radiation might be regarded by some as small lesions. I believe the largest lesion which I have treated in this manner was about 2 × 3

* Read at the Twenty-seventh Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Detroit, Mich., May 17–21, 1926.

inches. However, I am sure many of the irregular shaped lesions would have a larger total area than this.

Although there are many published statements to the effect that keloid tissue is very resistant to radiation, I believe that it is very susceptible to unfiltered rays and can usually be made to disappear entirely by doses which do not produce an erythema. Because an erythema is always undesirable if it can be avoided, each treatment should be definitely less than an erythema dose and the treatments should be spaced far enough apart to allow complete recovery between treatments. The interval between treatments should not be less than six weeks, and eight weeks is better. It requires a long time for these lesions to disappear and the involution will be just as rapid and and just as certain with one treatment every two months as it will with one every two weeks, and the danger of unpleasant consequences is much less.

The best result I have had was in a patient who never came back when he was told and whose average interval between treatments was three and a half months.

My usual practice is to apply 80 to 90 per cent of an erythema dose of unfiltered radiation of a quality corresponding to a 7 in. parallel gap and to repeat every eight weeks. The smallest number of treatments necessary has been two, the largest five.

In estimating the erythema dose, it is absolutely essential to consider the size of the area treated. If this point is neglected, disaster is sure to follow. It is well recognized that the size of the field has an important bearing on the dosage when using high voltage technique, but little attention seems to be paid to this factor in superficial therapy. While the amount of scattered radiation thrown back to the surface is undoubtedly much less, I am convinced that it is sufficient to be taken into consideration. In a hasty review of the literature, I have been unable to find any description of a method of accurately determining the amount of secondary radiation set up when treating small areas such as keloids. Bachem says, "the theory of scattered radiation is not yet sufficiently developed to enable an exact calculation of the scattered component," and again, "with small ports of entry the scattered component increases very rapidly with an increase in size of field."

By experience, I have found that the factors which I use in the treatment of keloids by unfiltered radiation will produce a faint erythema in an area ¼ in. square in seven minutes and that a similar reaction is produced in an area 2 in. square in three minutes. The majority of keloids will vary in size between these limits, and I attempt to judge the dose accordingly. When making this estimation, it is better to under-dose than over-dose, as severe reactions are undesirable and I believe unnecessary.

SUMMARY

1. Uniformly satisfactory results are obtained in the treatment of keloids with unfiltered roentgen rays.

2. The amount of radiation applied at each treatment should not exceed 90 per cent of an erythema dose.

3. In estimating the dose, careful attention should be given to the size of the area to be treated.

4. An interval of six to eight weeks should be allowed to elapse between treatments.

ABRIDGED DISCUSSION

Dr. H. K. Pancoast, Philadelphia. The first paper I was ever called upon to discuss I recall was in Baltimore in 1905 on this same subject. At that time I remember advocating the postoperative treatment of keloids. I still think this treatment may occasionally be necessary, especially in the linear ones but not as frequently as we used think it to be.

We employed the roentgen ray in the treatment of keloids for a number of years until radium came into use and then we used radium extensively, but looking back over our experience we came to the conclusion that we were not getting as good results with radium as we did with the roentgen ray, and since then we have stopped the use of radium. I think that agrees with the experience of Dr. Grier.

I also quite agree with him that an erythema is unnecessary and undesirable. Our usual practice is to give about three applications of one-half an erythema dose each from two to three weeks apart and then to wait a period

of at least six weeks before giving any more treatment, because undoubtedly in many keloids the growth will subside very materially in a time interval such as six weeks, whereas if the treatment is continued the growth will receive an unnecessary amount of radiation.

It is important also to protect the surrounding healthy skin. If this is not done and it is found necessary to treat the keloid longer than the average time, or more frequently than the average number of applications, the surrounding skin may become changed somewhat and later on there will be more contrast between the appearance of the skin covering the keloid and the skin immediately surrounding it.

We have used filters in all of our cases treated by roentgen rays, except in the earlier ones before filters were known. We use a rather heavy filter with a comparatively low voltage tube. Most keloids are thick, and extend down into the subcutaneous tissue for a considerable distance and the amount of radiation which goes beyond the subcutaneous tissue is not very great with a low voltage tube. If you use no filter at all or very little filter, you will not get very much radiation in the deeper parts of the growth, unless it is extremely superficial, and I think, therefore, that a filter is always desirable in the treatment of such cases.

I think, in the main, we all agree with the method of treating these cases from experience, and we differ only in the minor details such as the last one I mentioned.

DR. DAVID R. BOWEN, Philadelphia. I want to agree very largely with Dr. Grier, especially as to the size of the area. The erythema is not at all proportional to the size of the area.

Dr. Grier said seven minutes for a quarter inch square and three minutes for three inches square—not at all proportional, you see—and that has been my experience.

My technique has been very similar to Dr. Grier's, with just this modification: I have used a 30 cm. distance and a 7 in. gap for lesions that were not much elevated, and a 9 in. gap and a 40 cm. distance if the lesion was elevated.

There seem to me to be two kinds of keloids which require somewhat different handling. One of them is not disproportionate to the original wound, the original skin region; such are the vaccination keloids and the small burns, and these, as a usual thing, are not tender. Oftentimes if you ask the patient he will say they are tender, but if you distract his attention and stroke the lesion a little bit you will find he doesn't pay much attention to it.

The other type, like that which arises in an abdominal incision, shows a tendency to be much larger than in the original lesion and is almost invariably tender.

The first type I think tends to recovery. I have noticed this in a few cases, at any rate. My own boy had a vaccination scar raised, keloid in appearance, not tender, and if it had been any patient's son he surely would have been treated, but like a shoemaker's child, he wasn't, and he got just as well as the others. It took quite a long time, but he has a normal vaccination scar now. I know of one or two other cases. So there is good reason for going slow in these cases. We may get more credit than is due us. The other type of case, that is, the kind which is larger than the lesion and is painful, tends to increase in size and I think is much more rapidly amenable to treatment.

Within the last four months we had a very unpleasant experience with a keloid which nevertheless seems to have turned out very satisfactorily. It was on the back of a girl's hand where she had had a little burn. By a mistake on the part of my assistant, she got a heavy erythema dose, so that the lesion blistered and formed a crust, and the skin was not so well protected as it should have been and there was a stong erythema in that case. It gave us more uneasiness than I like to have, for a considerable length of time, but for two months now it has been very satisfactory and it seems that the one treatment is apparently going to work out as well as the divided ones.

DR. ALFRED L. GRAY, Richmond, Va. I have had a fair experience in the treatment of keloids. My method has been rather that of Dr. Pancoast's and Dr. Grier's, using a thin filter, perhaps not greater than 0.5 to 2 mm. Al, and protecting the area surrounding the keloid, except a rather narrow margin about it. This method has given uniformly good results except in one case..

I think there is unquestionably no treatment for keloids that can in any way compare with roentgen-ray treatment.

DR. GEORGE E. PFAHLER, Philadelphia. About four years ago I called attention to the value of excising the smaller, thick keloids, and I am sure when that is practical it will give quicker and better cosmetic results, but when the lesion is excised it must be followed, or better preceded by roentgen-ray treatment, and treated again within a week after the excision before there has been a chance for the scar to grow, and it should be treated again within another week sufficient to keep the scar from growing. So far I haven't had any of these keloids re-form under such

treatment. You can easily see, therefore, that you get quicker and better results when the lesion is so located that it can be excised. I have also in a few instances destroyed the keloid by electrocoagulation, following with roentgen-ray treatment to prevent a regrowth of the keloid.

Dr. Isaac Gerber, Providence, R. I. I just want to express a word of caution. I was interested to hear the discussion opened by Dr. Pancoast and to hear mentioned the use of filtered radiation. I feel that a word might well be said as to the danger of indiscriminate use of unfiltered radiation in keloids as well as in other conditions by persons who might read articles similar to that published under Dr. Grier's name.

It is perfectly true that in these conditions, the less the filtration the better the result, but in attempting to give 90 per cent of an erythema dose of purely unfiltered rays the margin of safety is very slight. When Dr. Grier himself gives that dose, undoubtedly he can hold very close to the limits of 90 per cent. If an assistant, a technician, or as will probably happen through the country, and is happening, persons with very little therapeutic experience attempt to give a 90 per cent dose, an error of merely five or ten seconds at either end of the application of the dose will make an enormous difference, and it is very easy to get an erythema without any intention of so doing.

Personally, I feel that the difference in the therapeutic effect on keloids between a purely unfiltered dose and a dose that results from rays applied with half a millimeter or even one millimeter of aluminum is practically negligible. The time element may be a little bit longer but we are not dealing with a condition in which there is any great necessity for rushing the cure. Personally, I have had uniformly gratifying results from the use of a slight amount of filtration and I feel that the danger is practically obviated.

Dr. A. H. Pirie, Montreal, Canada. Difference in opinion as to the treatment of keloid rises to a certain extent from not getting good results. This is the surface of the skin and this is the place where the cells divide quickly. Keloid is formed by multiplication of these cells which pile up until at last they form a mass under the skin, forming fibrous tissue. These cells are dividing quickly. The same principle applies here as in giving an epilation dose for the permanent removal of hair. That is the principle on which a keloid ought to be treated. We want to go on stunning these cells with a dose at good long intervals until they are knocked out, then nature steps in and removes the fibrous tissue when it is no longer being formed by these cells. It doesn't matter whether it is done with hard rays or soft rays.

Dr. James W. Hunter, Jr., Norfolk, Va. I should like to ask Dr. Grier if he found any difference between the reaction of negroes and white persons in the treatment of keloids.

Dr. Grier (closing). I am sure I have tried every method of treatment that has been described by the discussants several times and I have found by experience that I get the best results with unfiltered radiation. I will admit that that was more or less of an empirical conclusion, but I think that there is a scientific explanation at the bottom. Dr. Pancoast stated that if the lesion was thick, you needed penetrating rays to go to the depth of the lesion. What difference does it make whether you destroy the lesion from above downward or from below upward? The unfiltered radiation may not go more than 2 or 3 millimeters below the surface of the lesion, but suppose you destroy 3 millimeters of the lesion from the surface with your first treatment and then allow an interval of two or three months. The lesion is then 3 millimeters thinner than it was when you started; then give another dose of unfiltered radiation and take off 3 more millimeters from the top. I think that is the reason why unfiltered radiation works just as well in thick lesions as filtered radiation. As a matter of fact, I know from experience it works better.

It is certainly true that filtered radiation is not as efficient in its biological effect on epithelial tissue as unfiltered radiation; everybody will admit that.

It is also not true, as Dr. Gerber said, that the reactions from filtered radiation are better than from unfiltered. A roentgen-ray burn produced by filtered radiation is much more stubborn than one produced by unfiltered radiation. Anyhow we are not going to produce roentgen burns by this technique. I stated that 90 per cent of an erythema dose should not be *exceeded*. I said that I gave from 80 to 90 per cent. I did not say that I gave 90 per cent. I said 90 per cent should not be exceeded.

I want to go on record here as stating that I think no technician should ever treat anything. I will go further and say that I think anybody who does any kind of roentgen-ray treatment ought to know when he has given 90 per cent of an erythema dose; at least he ought to know what an erythema dose is and he ought to be able to figure 90 per cent of it.

There is a big difference between the radiation through one millimeter filter and through no filter. I am not enough of a physicist to state what that difference is. I am sorry I don't see any of our physicists here, but I am certain

that one millimeter of aluminum cuts out at least 75 or 80 per cent of the radiation from a tube so that there is quite a difference between radiation through one millimeter filter and through no filter.

In regard to the treatment of very large lesions, the largest lesion I have treated I think was about 2 by 3 inches. Usually these lesions are not square lesions; they are usually irregular in shape. A patient gets a burn and the keloid extends out something like a spider, with limbs projecting out. If the lesion were very large I would treat it in parts; I would treat a part of it at one time and a part at another. There is no great hurry about this treatment. It takes a good while for the patent to recover anyway, and if the lesion was so large that it would be unsafe to treat the whole lesion at once, I can see no objection to subdividing the lesion for the purposes of treatment.

In answer to Dr. Hunter's question, the colored population in our town has not been sufficiently thoughtful about the appearance of their keloids to consult me for treatment. I have never treated a negro, so I do not know whether there would be any difference in treatment or not.

I assumed that any one who would treat a keloid would protect the normal tissues. I took it for granted that the surrounding tissues would be protected with lead foil before treatment was started.

DR. G. E. PFAHLER, Philadelphia. I would like to make an explanation of my discussion for fear I may have given the wrong impression with regard to excising these keloids. When they are excised, the surgeon should cut as near the keloid as possible and save as much of the skin as possible. That is the point I should have made in my original discussion.

DR. DAVID R. BOWEN, Philadelphia. When I said "assistant," I meant medical assistant, of course.

THE MEASUREMENT OF ROENTGEN-RAY QUALITY BY MEANS OF THE PHOTOGRAPHIC DETERMINATION OF THE HALF VALUE LAYER*

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IN view of the present day uncertainty regarding roentgen-ray dosage and since the problem of standardization is in many quarters now under consideration, our experience for the past ten or twelve years and methods developed may prove of value.

This being a teaching institution, it became absolutely essential that some simple inexpensive methods be devised that would at least minimize those errors caused by the factors influencing radiation to the greatest extent.

From a physical standpoint certain fundamental laws must be recognized:

1. The roentgen effect is directly proportional to the quantity of radiation as well as the time; these being effective from either the physical or biological viewpoint (providing in the latter the radiation be intensive and uninterrupted).

2. The inverse square law pertaining to skin focus distance is (under usual working conditions) effective as regards comparative surface intensity measurements.

3. For practical purposes, all other factors remaining constant, the primary intensity varies directly as the square of the voltage; this again only from the physical standpoint under average working conditions.

It will be noted that the foregoing has reference mainly to the physical dose measurements. The relation of measured intensity to biological effect is a far more complicated matter; the latter probably

* Presented in a demonstration before the New York Post Graduate Research Club.

depending upon the total absorbed energy. On the other hand, the uncertainty of the biological effect is neither reason nor excuse for neglecting a reasonable attempt at standardization and of associating biological effects with comparative physical dose measurements.

More than 10 years ago it was our fortune, or misfortune, to have three different types of machines in the department. In attempting to produce the same relative quality and quantity of radiation with each of these, such variations in the formula $\frac{A \times V^2 \times T}{D^2} = I$ were necessary as to cause relative intensity figures in the ratio approximating $1 - 2$ and $1 - 3\frac{1}{2}+$; in other words, there was almost 400 per cent intensity variation between these machines.

By changing the milliampere-meter from one machine to another and employing the same tube, focal distance, milliamperes and time, it becomes quite apparent that the factor responsible for the greatest variation is the measure of the spark gap or electric tension. Many tests on various installations as well as reference to reliable publications reveals the futility of employing the spark gap or voltmeter as a *comparative* quality measure for transference of technique from one installation to another.

The following table is an abstract of a presentation of standardization data in an article in Radiology, April, 1926.[1]

Number of machines investigated: 70

Types of machines: Transformer with mechanical rectification; Induction coil; High tension direct current apparatus.

Makes of machines: 10

Largest difference in time to produce with different machines for the same treatment conditions an erythema dose equivalent to 1300 R units (for hard rays, half value layer; 14 mm. aluminum) 80 per cent.

Largest difference in time to produce with different machines for the same treatment conditions an erythema dose equivalent to 500 R units (for soft rays, half value layer 1.6 mm. aluminum) 160 per cent.

Once the quality and quantity of radiation with a given tube, on a certain installation are known, then it is perhaps justifiable to use the spark gap or voltmeter as a test of quality and a milliampere-minute technique as quantitative measure, so that routine operating conditions may be obtained. However, such data are by no means transferable to another installation even of the same manufacture, nor to another tube on the same equipment; nor

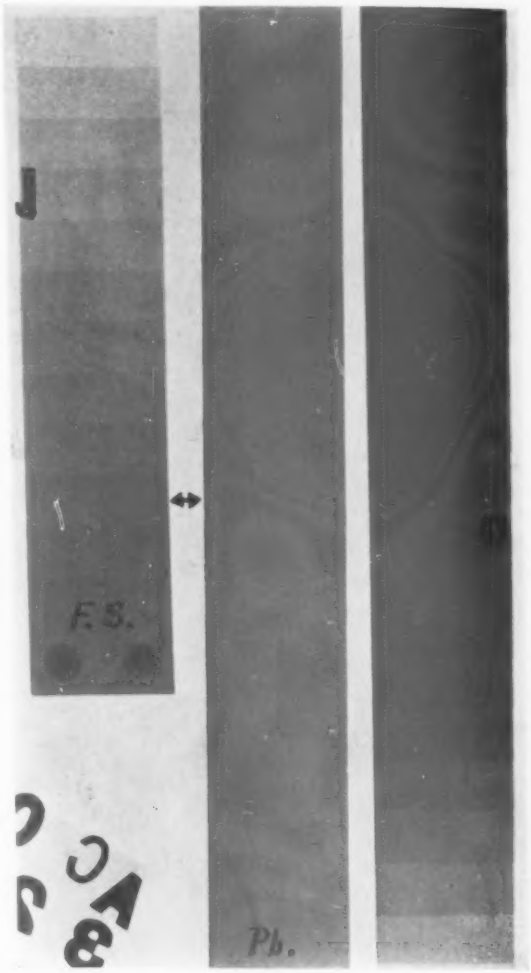

Fig. 1.

when alterations or repairs have been instituted; furthermore, time and weather conditions also cause variations which together with all the other variables demand constant rechecking which can only be accomplished by direct measurement of the roentgen-ray beam.

Of the many quality measures presented, the one that affords a reasonable degree of certitude and requires but little

[1] Meyer, W. H., and Glasser, O. Erythema doses in absolute units. *Radiology*, April, 1926, vi, 320–328.

special equipment and therefore the one upon which our system is built is along the lines described by Christen, namely, of determining the half value layer. In other words, of finding that thickness of a given substance that cuts the intensity in half. It is at once apparent that the more penetrative rays will show a higher half value layer than the softer rays.

Though the method herewith described has probably been employed in various ways by others, yet from what I can find in the literature I believe that we were one of the first to employ and teach a simple procedure requiring only a piece of lead, an aluminum ladder and common photographic materials.

The determination of the half value layer by this method is accomplished in the following manner:

Two metal ladders are used for the greater number of experiments, one is made of aluminum graded in one millimeter steps, from 1 to 20; another ladder is graded in 0.25 mm. steps, 12 steps in all, these 12 steps therefore represent 3 mm. A third ladder of copper in 0.1 mm. steps has more recently been added, this ladder tending to minimize some of the difficulty encountered with scattered radiation when rays of very short wave length are employed. These scales are further supplemented by the addition of strips of aluminum each 1 mm. thick.

The fine aluminum scale in 0.25 mm. aluminum steps is used for testing unfiltered or weakly filtered rays; the coarse aluminum ladder and copper scale are employed for the more strongly filtered rays.

The method of procedure is as follows: On a photographic film in a light proof envelope, the ladders are placed along side of a thick strip of lead about 1 in. wide and long enough to parallel the length of the ladders. With a given formula (see table) a short exposure is made, the strip of lead is then removed and another exposure of exactly the same time and under the same conditions is repeated, this without disturbing the position of the ladders. Since that part of the film, where the lead was, receives half of the exposure of the balance of the film it will naturally record only half the intensity. After developing the film, the intensity values under the ladders are compared with the half intensity shadow under the lead. It is evident that where the two shadows match, the thickness of aluminum necessary to cut the intensity in half will be indicated. This thickness thus indicates directly in millimeters the half value layer of aluminum or other material used for the particular radiation tested.[1]

Since the half value layer indicates the radiation quality of the roentgen-ray bundle directly, it gives more reliable information of the quality than spark gap or kilovolt reading. As a matter of fact, machines and tubes delivering the same quality of roentgen-ray beam as tested by the half value layer, may vary in their spark gap readings as much as 100 per cent. A concrete example before cited states that three different machines set to produce the same half value layer (i.e. +1 mm. Al) varied in their spark gap readings as wide as 4−, 5− and 7½+ inches; therefore spark gap readings are not transferable from one machine to another, since with the same spark gap setting on the three different machines a distinct variation in the half value layer occurs with a corresponding variation in intensity amounting to almost 400 per cent.

The settings and exposure times have to be worked out for each individual installation. A little practice will soon show the proper settings and exposure times. The exposures must, of course, not exceed the sensitivity of the film emulsions used; this is accomplished by varying the time of exposure so as to obtain fairly uniform intensity values on the different tests thereby minimizing photographic errors.

The data in the following table are given as working suggestions and should serve as landmarks for similar determinations on other machines. Though the spark gaps on other installations may vary considerably with respect to the other data, yet the relation of the half value layer and time of exposure will be found within reasonable limits.

The study and determination of the half value layer has several practical applications:

[1] Eastman (single coated) Process Film, size 5″ × 7″, i.e. a film of low sensitivity, has been found most suitable for the experiments. The developer used is one-half strength at a temperature of approximately 65° F. The time of development is six minutes.

1. In the preceding pages it has already been inferred that the determination of the primary roentgen quality by means of the half value layer is superior to any of the devices that depend upon the measurement of electrical tension.

ILLUSTRATING THE APPLICATION OF THE HALF VALUE LAYER AS THE MEASURE OF QUALITY

Focal film distance for all exposures: 32″

Half Value Layer in Mm. Al	Filter 1.5 Mm. Fibre+	Ma.	Exp. Time $t+t$ in Seconds	Spark Gap	Peak Kv.
1+	—	10	10 + 10	+4″	70
$1\frac{1}{2}$+	—	8	6 + 6	$6\frac{1}{4}$″	100
3+	2.5 mm. Al	8	15 + 15	$6\frac{1}{4}$″	100
2−	—	5	4 + 4	$9\frac{1}{2}$″	135
4−	2.5 mm. Al	5	10 + 10	$9\frac{1}{2}$″	135
6−	4.5 mm. Al	5	15 + 15	$9\frac{1}{2}$″	135
9−	0.25 mm. Cu +1 mm. Al	5	25 + 25	$9\frac{1}{2}$″	135
11−	0.5 mm. Cu +1 mm. Al	5	45 + 45	$9\frac{1}{2}$	135
12+	0.5 mm. Cu +1 mm. Al	$3\frac{1}{2}$	30 + 30	$15\frac{1}{2}$	215
14+	0.75 mm. Cu +1 mm. Al	$3\frac{1}{2}$	50 + 50	$15\frac{1}{2}$	215

Absolutely unfiltered rays are not used, we always have 1.5 mm. of red fibre which is practically equivalent to 0.25 mm. Al as a screen. Without this fibre the half value layers would be less than given in the table. All ladders used should be carefully tested both with respect to their thickness and purity of material. As noted in the text, the spark gap and kilovolt readings on other installations may vary considerably from those given in the table. This however is the very purpose of substituting the half value layer as the measure of quality irrespective of what the spark gap may be.

2. The determination of the half value layer with filtered rays is just as easily accomplished as with the unfiltered.

Since the half value layer in aluminum as herein described extends through a wide range and permits of simple and direct readings, it is superior to either the method of measuring the effective wave length, or that of determining the average quality by means of the spectrum.

3. The simplicity and inexpensiveness of the procedure is also a matter of consideration.

4. A study of experiments conducted with progressively increasing filter thicknesses will reveal that filter (with a given primary quality of radiation) best suited for practical working homogeneity. No filter, as employed today for deep roentgen therapy, results in absolute homogeneity. The application of strictly homogeneous radiation with present day methods would require an unreasonable time factor; therefore when progressively increasing filter thicknesses no longer result in pronounced improvement in the half value layer then has practical working homogeneity been obtained.

5. Providing all the usual operating conditions be kept constant with uniformity of development, then a cue as to the intensity values of two installations may be obtained if the half value qualities are the same; however the method is not intended for the determination of intensity values. The ionization method appears to date the best evolved for the measurement of roentgen intensity; on the other hand, *neither ionization nor any of the other intensity measurements can be applied in association with the biological dose over the whole scale of varying wave lengths without due consideration of the quality*. It is in this connection that the determination of the half value layer finds one of its most practical applications.

6. The ladders and lead strip can also be employed to test the three-fourths, two-thirds, one-third, and other intensity layers by changing the relative time of exposure between the aluminum scale and the lead block in such a way as to produce fractional exposure intensity on the space covered by the lead. In this way transmission and absorption curves in aluminum can be produced.

7. By associating the transmission and absorption in aluminum with that in water under various conditions, a definite relation between the half value layer and the depth dose can be established, thereby providing a working hypothesis as regards deep roentgen therapy.

Items 5, 6, and 7 are inserted here to reveal the greater practical application of the determination of the half value layer. These are matters undergoing further investigation by Dr. Glasser and myself and are deserving of separate consideration, this article being limited to the presentation of a preferential method of determining roentgen-ray quality by means of the photographic determination of the half value layer.

THE SIGNIFICANCE OF THE HISTOLOGICAL "MALIGNANCY INDEX" FOR PROGNOSIS AND TREATMENT OF CARCINOMATA OF THE CERVIX UTERI*

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MANY attempts have been made to correlate the histopathological findings with the clinical prognosis in carcinomata. We are reporting here our first communication that represents the combined efforts of pathologist and clinician working together for the purpose of ascertaining if a pathologist can include in his report information that will assist the clinician in prognosis and treatment of carcinomata.

Schottlaender and Kermauner[1] divided the carcinomas of the uterus into solid and glandular forms; each of these were then subdivided into (*a*) adult, or ripe; (*b*) medium; and (*c*) immature, or unripe types. This represents an effort toward a correlation of the cell types composing the tumor and the relative malignancy of the growth. But von Franqué,[2] Lahm,[3] and others were unable to find a connection between the histological cell types and the clinical course of the malignancy. Broders[4] showed a very definite connection between the cellular differentiation of the skin carcinomas and the clinical end results obtained after treatment. Martzloff[5] classified solid carcinomas of the cervix according to the relative degree of maturity of the component cellular elements. This author differentiates between three large groups: (*a*) spinous cells—similar to those found in the superficial layer of cervical squamous epithelium; (*b*) transitional cells; and (*c*) fat spindle cells—similar to those found in the basal layer of the cervical epithelium. The transitional cell cancer is made up of cells that are found between the superficial and basal layers of the cervical squamous epithelium. Martzloff reports a better end result in the spinous cell carcinoma, namely 47 per cent; in the transitional cell types 24 per cent; and in the basal cell carcinomas only 9.5 per cent. Greenough's[6] recent contribution upon breast tumors is a landmark in this field of work. He found a very definite relationship between the degree of relative malignancy and the prognosis of breast carcinomas. Greenough based his relative malignancy upon the degree of differentiation and anaplasia found upon histological examination. The irregularity in size of the cells and the nuclei, hyperchromatism, mitoses, and functional activity (secretory) were the criteria used to determine the relative malignancy. This author divided the breast carcinomas into three groups: low, medium and highly malignant. The end results of treatment were found to correspond very well with the degree of histological malignancy of the carcinoma.

We shall not attempt a complete review of the literature at this time, but we are convinced that all investigators regard the carcinomas composed of poorly or low differentiated cells with unquestionable anaplasia as much more malignant than cancers with fully differentiated cells and little evidence of anaplasia.

Greenough could not find a definite connection between the size of the cells and the nuclei and the relative malignancy of the tumor. Palugyay[7] called attention to the relatively small nuclei in the immature or unripe carcinomas and the larger nuclei in the more mature or ripe types. We all know that some of the most rapidly growing carcinomas are composed of small cells. We are not yet in a position to make definite statements upon this point, but we are inclined to agree with Böhm and Zweifel[8] that the "cytoplasm nucleus ratio" is of value, but it is the ratio of the two and not each individual

* Read at the Eleventh Annual Meeting, AMERICAN RADIUM SOCIETY, Dallas, Texas, April 19 and 20, 1926.

factor that will prove to be of value. A large nucleus and small amount of cytoplasm is probably indicative of a higher potential malignancy than a large amount of cytoplasm and a relatively smaller nucleus.

The classification we have followed divides the carcinomata of the cervix into two large groups: the primary or solid, and the tubular or glandular carcinomas. This is based upon the general structure of the tumor and does not refer to the cellular origin of the particular type of cell predominating in the malignant growth. The subdivisions of these two main groups do not refer to their origin from any portion of the epithelial layer, but are based upon morphological findings that characterize in a general way their degree of differentiation and their relative proliferative activity. The following classification is given in detail with the facts in mind which we have just stated, as to a morphological similarity with the normal cell and not a true histogenic derivative of these cells.

CLASSIFICATION

A. Primary solid carcinomas.
   1. Spinous cell carcinoma with cornified pearls.
   2. Spinous cell carcinoma without cornified pearls.
   3. Round cell carcinoma.
   4. Spindle cell carcinoma.

B. Glandular carcinomas.
   1. Malignant adenoma.
   2. Papillary and gelatinous adenocarcinoma.
   3. Adenocarcinoma.
   4. Solid adenocarcinoma.

DEFINITIONS

A. Primary Solid Carcinomas:

1. *Spinous cell carcinoma with epithelial pearls* (Fig. 7).

This tumor is composed of large, flat, polygonal, well-defined adult epithelial cells. The cells in the periphery of the carcinomatous nests frequently show delicate intercellular processes. The nuclei are round or oval, large, stain moderately with hematoxylin and contain one or two nucleoli. The cytoplasm is abundant and stains palely with eosin. The cells are often arranged in concentric layers. The cells near the center become more irregular in shape, elongated and pointed toward the ends and show keratin granules and cornification, while the center is represented by a homogeneous, distinctly eosin stained cornified material sometimes containing pycnotic nuclei.

2. *Spinous cell carcinoma without epithelial pearls* (Figs. 5 and 6). The component cells are morphologically similar to those described above, except that the intercellular processes are more prominent, resembling the prickle cells of the normal epithelium. Cornified pearls are absent or are found only in traces in isolated areas.

3. *Round cell carcinoma* (Figs. 3 and 4). This tumor is composed of small round cells. The cell membrane is not so clearly defined. The cytoplasm is smaller in amount and takes a deep eosin stain. The nucleus is round and uniformly stained and possesses one or more nucleoli.

4. *Spindle cell carcinoma* (Figs. 1 and 2). This tumor is composed of small, slender, poorly defined, spindle shaped cells. There is a scanty amount of eosin staining cytoplasm in which an oval shaped deeply blue staining nucleus is found. The cells grow densely packed in solid nests or columns, frequently of gyriform character. By the contact of two columns pseudoglandular formations are sometimes produced. The same impression may be created by the frequent central necroses in the solid nests or by the lining of lymphatics with these cells especially if they exhibit a radiating arrangement.

B. Glandular Carcinomas.

1. *Malignant adenoma* (Fig. 12). This is a purely glandular structure with cylindrical cells resting on a basement membrane. The nuclei are single layered and sometimes oval shaped and located at the base of the cells. The stroma is very scanty and just suffices to serve as supporting framework so that a dos-à-dos position of the glands results.

2. *Papillary and gelatinous adenocarcinoma* (Figs. 10 and 11). (*a*) The type of cells observed in the papillary adenocarcinoma is the same as in the previous

type, but papillary proliferations of the carcinoma cells are frequently present which may fill the whole lumen. It is a type of higher structural differentiation. The cells are more regular than in the adenocarcinoma (Fig. 10). (*b*) This type forms solid nests and massive cellular proliferations rather rarely. The lumina are distended with cystic formations. Desquamation and mucoid degeneration of the tumor cells are frequently observed (Fig. 11).

3. *Adenocarcinoma* (Fig. 9). The cells in this type vary in form from cylindrical to cuboidal or round. They are variable in size. Giant cells may be present. Moreover, the outlines of the cells are sometimes indistinct, resulting in the formation of large masses of cytoplasm containing many nuclei. The nuclei are round or oval, vary

FIG. 1. Spindle cell carcinoma (low magnification).

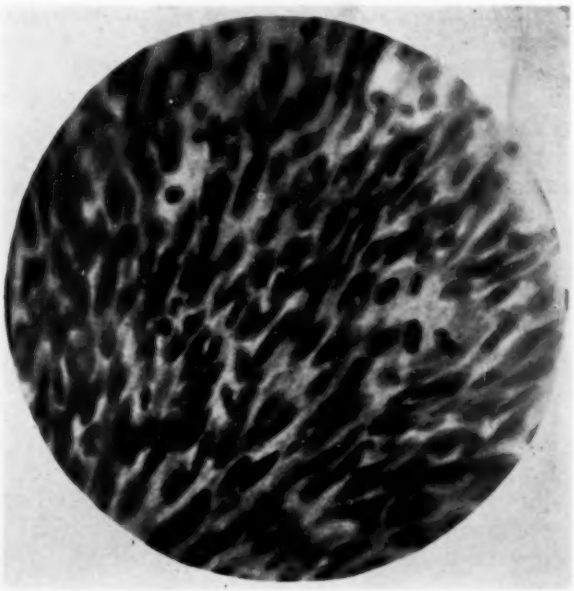

FIG. 2. Spindle cell carcinoma (high magnification).

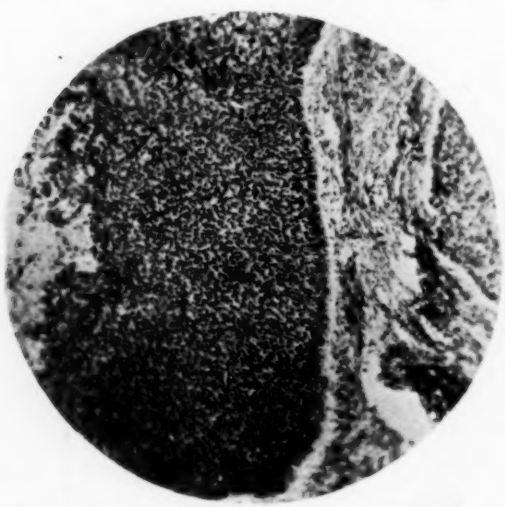

FIG. 3. Round cell carcinoma (low magnification).

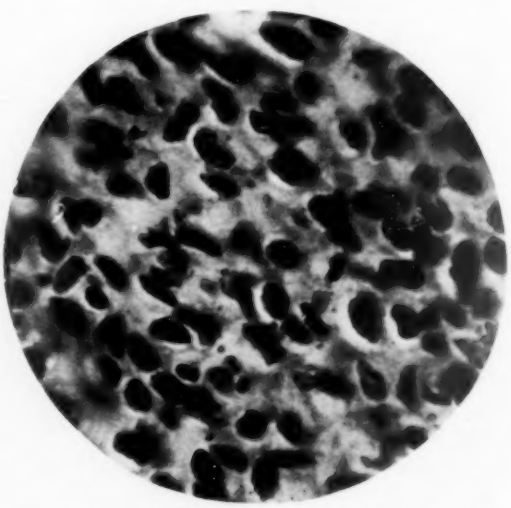

FIG. 4. Round cell carcinoma (high magnification).

in size and show a coarse chromatin network without distinct nucleoli. A single layer is seldom found. A basement membrane may or may not be present. Mucus may be found in the lumen of the glandular formations and in vacuoles in the cells themselves.

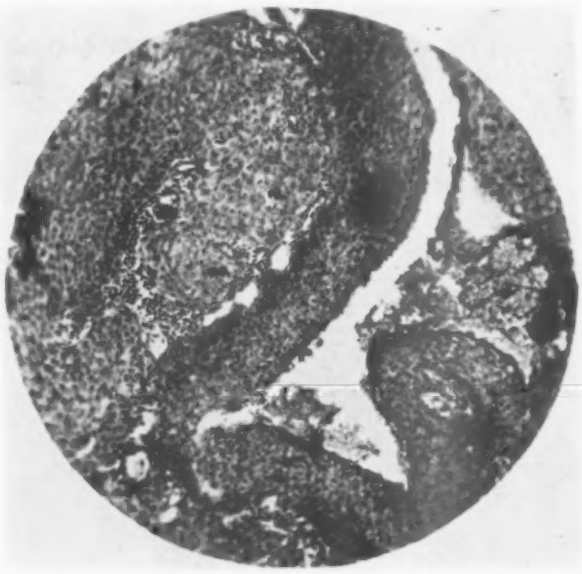

Fig. 5. Spinous cell carcinoma without cornifications (low magnification).

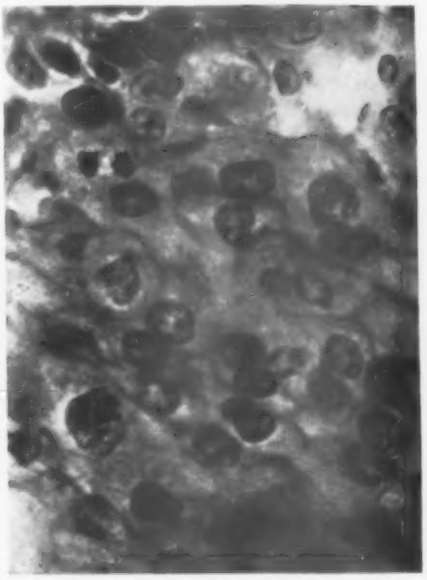

Fig. 6. Spinous cell carcinoma without cornifications (high magnification).

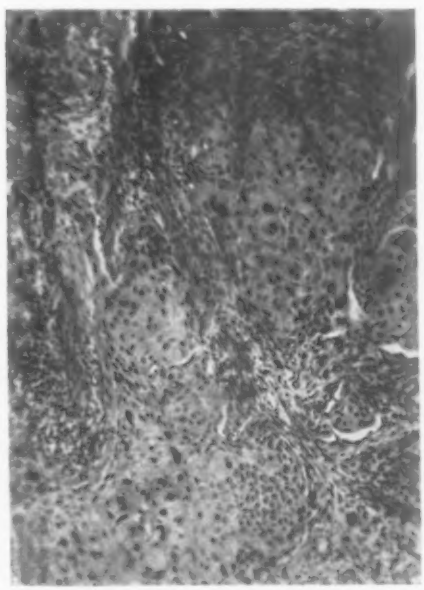

Fig. 7. Spinous cell carcinoma with cornifications (low magnification).

Fig. 8. Solid adenocarcinoma (low magnification).

4. *Solid adenocarcinoma* (Fig. 8). The cells in this type are more irregular in shape and size, sometimes resembling squamous cells but they are mostly swollen cells. They show a gray violet cytoplasm and relatively small nuclei. They grow in solid nests showing a remarkable uniformity in structure in contrast to the primary solid carcinoma with their marked

irregularity. Usually glandular formations are present in isolated areas showing the true character of such growth.

We have attempted to evaluate as many factors as was possible in our histological preparations and have found that for purposes of numerical expression certain values could be given to definite degrees of deviation from the average cell types present in the tumor. The following nine factors were given certain numerical values as will be mentioned below. We are now attempting to evaluate radiation sensitiveness of carcinomas of various types and are finding that the above mentioned nine factors are too incomplete to express the changes that take place. This will be published in the near future.

FIG. 9. Adenocarcinoma (low magnification).

FIG. 10. Papillary adenocarcinoma (low magnification).

DEFINITIONS OF THE NINE FACTORS USED FOR THE DETERMINATION OF THE HISTOLOGICAL MALIGNANCY

1. *Special Cell Type of Carcinoma.* Each of the four sub-groups of carcinomas were used as a basis in this special cell type classification. The cornified spinous cell carcinoma was given a value of 2; uncornified spinous cell carcinoma a value of 4; round cell carcinoma a value of 6; and the spindle cell carcinoma a value of 8. The same general scheme was carried through with the glandular carcinomas. The maturity of the majority of cells present was the main factor used to determine this grouping. The more embryonal and anaplastic the component cells, the greater is the proliferative power and the higher the potential malignancy.

2 and 3. *Irregularities in Size and Shape of the Cells.* The average shape or size was studied. If 50 per cent of cells showed irregularity in size and shape then the value 4 was given; if 30 to 40 per cent, the value 3; if 20 to 30 per cent, the value 2; and if 10 to 20 per cent, the value 1.

4. *Distinctness in Outline of the Cells.* The cells with distinct and sharp outline were evaluated as 1. If 50 per cent were indefinite in outline the value 2 was given; if 75 per cent, the value 3; and if more than 75 per cent had an indefinite outline a value of 4 was given.

5. *Functional Activity of Cells.* This was estimated from the presence in the

cells of keratin granules, mucus, and so forth. If the majority of the cells showed a functional activity, the value 1 was given. Minor degrees were evaluated as 2, 3, and 4 respectively. The same relative percentages were used as in the previous standards.

6 and 7. *Irregularities in the Size and Shape of the Nuclei of the Cells.* The size and shape shown by the majority of the nuclei present were taken as the standard size and shape. A deviation of 50 per cent from this standard was evaluated 4; a deviation of 30 to 40 per cent 3; of 20 to 30 per cent as 2; and less than 20 per cent as 1.

8. *Staining Quality of the Nuclei.* Cells containing nuclei taking the stain as intensely as the nuclei of lymphocytes were considered hyperchromatic. When 25 per cent of such hyperchromatic nuclei were present, the value of 4 was given; 20 to 25 per cent a value of 3; 10 to 20 per cent a value of 2; and 5 to 10 per cent a value of 1.

9. *Number of Mitoses and Prophases.* These two were counted separately but considered together as indicative of proliferative properties. Ten fields were counted with oil immersion lens (1050 × magnification) giving us an actual count on the mitotic figures on which to base our estimate of proliferative activities of the carcinoma examined. In case 20 or more mitotic figures were seen in the 10 fields, a value of 4 was given; 15 to 20 mitoses were evaluated as 3; 10 to 15 as 2; and below 10 as 1.

An examination of the tables will show how the numerical values of the various factors are put in a certain system which was named "malignogram" (Hueper) and when added together give a number to which the term "histological malignancy index" (Hueper) was applied. The first question that arises when looking over such a table is: Why such a complicated procedure to evaluate relative malignancy of a carcinoma? We are fully aware of the apparent fact that most all of the nine headings we have in the estimation tables mean about the same when evaluated in low or high numbers. For instance, if the tumor is a keratinized spinous cell carcinoma, then all of the remaining eight factors are usually low in their numerica

FIG. 11. Gelatinous adenocarcinoma (low magnification).

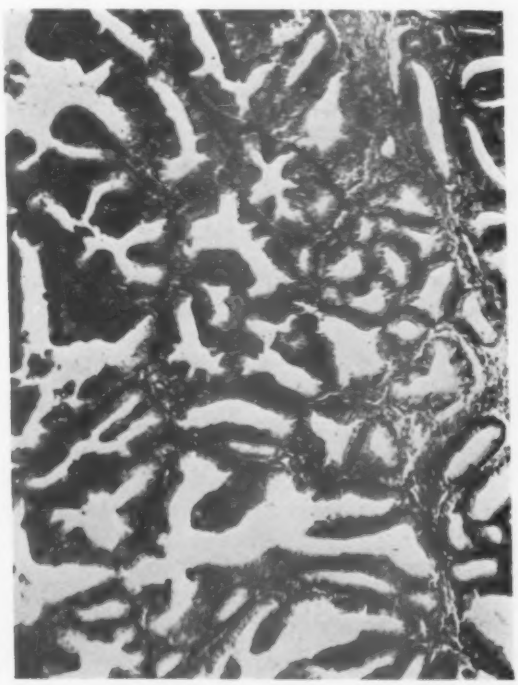

FIG. 12. Malignant adenoma (low magnification).

value, that is they approximate more nearly the adult, differentiated mature type of cells. On the other hand, if it is a spindle cell carcinoma, the opposite extreme is usually true; that is, all the numbers are high in their values and the tumor is composed of immature, undifferentiated cells with a relatively high potential malignancy.

Unless all of these factors are carefully taken into consideration and the total information thus gained is carried over and compared with the clinical diagnosis and the clinical result of treatment, then real progress cannot be made in this field of work. The cases of most interest are those that do not follow the expected rule. These are now receiving our special attention.

We shall undoubtedly add other factors and most probably omit some of the ones we have reported here, but we feel that it is only by pursuing such careful, painstaking work—omitting nothing that might possibly be of value—that real progress can be made.

The work we have done upon the evaluation of the malignancy of carcinoma of the cervix includes the consideration of the maturity of the cells (Martzloff), the degree of differentiation (Broders) and all of the important criteria used by Greenough. In addition a correlation of all of these factors is attained and evaluated in definite terms that can be seen at a glance. Their interpretation can then be made by the clinician in terms of his experience. The following is a tabulation of the 135 cases examined from a purely pathological standpoint. These cases were admitted during the years 1922 to 1925 inclusive.

1. Spinous cell carcinoma with cornifications	4	1. Malignant adenoma	1
2. Spinous cell carcinomas	36	2. Papillary and gelatinous adenocarcinoma	8
3. Round cell carcinomas	48	3. Adenocarcinoma	12
4. Spindle cell carcinomas	20	4. Solid adenocarcinoma	6

The average malignancy index of

1. Spinous cell carcinoma with cornifications is	18.5	ranging from 12–23
2. Spinous cell carcinoma	19.4	ranging from 10–28
3. Round cell carcinoma	24.33	ranging from 17–33
4. Spindle cell carcinoma	28.55	ranging from 22–39
1. Malignant adenoma is	13.0	ranging from –13
2. Papillary and gelatinous adenocarcinoma	19.25	ranging from 13–25
3. Adenocarcinoma	20.5	ranging from 16–24
4. Solid adenocarcinoma	25.5	ranging from 19–33

The above evidently shows the importance of the cell type for the malignancy index, but at the same time the cell type alone is not the absolute decisive factor for the malignancy of a tumor.

Sections were taken from several different places in carcinomas of the cervix of three uteri; two removed at operation, and one obtained post mortem. A malignancy index was computed for each section examined. The average variation was not over three points or numbers. We feel that we are justified in considering therefore the malignancy index as constant for most of the tumor when the section is properly taken from the center of the growth. Sections obtained from the very periphery of the tumor do not always give trustworthy indices,—the malignancy index is then usually higher due to the reaction and physical changes in the adjacent tissues. The cells, then, have a tendency to be more irregular in shape and size.

We take the liberty of outlining some of the additional factors we are now studying to arrive at a malignogram that should increase the value of such a compilation for determining relative malignancy.

1. Special type of the carcinoma.
2. General type of the carcinoma.
3. Absolute size of the cells.
4. Irregularities in size of the cells.
5. Absolute shape of the cells.
6. Irregularities in shape of the cells.
7. Distinctness in outlines of the cells.
8. Staining quality of the cells.
9. Functional activity of the cells.
10. Absolute size of the nuclei.
11. Irregularities in size of the nuclei.
12. Absolute shape of the nuclei.
13. Irregularities in shape of the nuclei.
14. Absolute staining quality of the nuclei.
15. Irregularities in the staining quality of the nuclei.
16. Number of mitoses and prophases.
17. Irregularities in form of the mitoses.
18. Character of the stroma.
19. Vascularity of the stroma.
20. Degree of round cell infiltration.
21. Character of round cell infiltration.

THE RELATION OF THE HISTOLOGICAL MALIGNANCY INDEX TO THE CLINICAL COURSE AND THE RESULT OF RADIUM AND ROENTGEN-RAY TREATMENT

For the study of the prognostic significance of the malignancy index to the clinical course of carcinoma of the cervix 61 of the 135 reported cases were available. These had either survived a three-year period and were anatomically well or had succumbed to the disease. The other cases were of recent date and will be reported in a future communication.

The cases were graded according to the extent of the disease elicited by a physical examination and the end result of treatment.

We have used four groups to designate the extension of the carcinomatous growth in and around the cervix: Group 1. The clearly and definitely "localized" carcinoma; Group 2. The borderline carcinoma, in which the disease had extended so that an invasion of the paracervical regions had to be assumed, though the uterus was freely movable and the parametria were free from invasion; Group 3. The clearly inoperable carcinoma with extension into the parametrium; and Group 4. The advanced carcinoma with fixation of tissue and widespread extension, distant metastases, and so forth.[9]

The clinical malignancy of the cases was graded according to the results of treatment:

Clinical result 1: The patient was free of symptoms and showed an anatomic healing for three years. Clinical result 2: The patient lived from two to three years. Clinical result 3: The patient lived from one to two years; and Clinical result 4: The patient lived up to one year.

The value of such grouping of the extent of the disease and grading of the result of treatment is dependent on the fact that all cases were examined and treated with the same method and the same technique. The cases, reported here, were all under the supervision of one clinic and of the same clinicians. The technique of treatment employed has been reported in another communication.[9] The method was the combined radium and roentgen-ray treatment. None of the cases had been subjected to operation either before or after the radiation treatment, except case protocol Number 92.

Table 1 shows the first page of our ten-page protocol that represents a tabulation of the 135 cases of our experiment.

TABLE 1

Case number	950	1318	1344	1397	1639	1584	1627	1661	2327	2294	1626	2366
Special type	8	6	4	8	6	4	8	A8	6	4	6	6
Irreg. in size of cells	3	1	1	2	4	2	2	1	4	2	3	2
Irreg. in shape of cells	4	1	2	3	3	3	2	4	3	3	3	2
Distinctness in outline	4	2	2	3	3	2	3	3	2	2	3	2
Functional activity	4	4	1	4	4	2	4	2	3	4	4	4
Irreg. in size of nuclei	3	1	2	1	4	1	2	1	4	2	4	4
Irreg. in shape of nuclei	3	1	4	3	3	1	1	1	2	1	3	2
Hyperchromatism	4	1	2	2	1	1	1	2	4	1	3	3
Mitoses and prophases	4	4	1	3	1	2	2	1	2	4	1	4
Malignancy index	37	21	20	27	29	18	23	23	30	23	30	29
Clinical group	3	3	2	2	4	3	3	3	4	3	3	4
Clinical result	4	1	2	4	4	1	2	3	3	2	3	3

This is shown for the purpose of indicating in detail the method used in obtaining the malignancy index. The last two lines were filled in with the aid of the hospital records of the case in question and after the histological malignancy index had been determined.

Table II was made from the whole protocol. This contains in column 1 the protocol number, in column 2 the cell type, column 3 the histological malignancy index, column 4 the clinical group or extent, and column 5 the clinical result. Therefore it contains the 60 cases which could be used for the study of the prognostic significance of the malignancy index. From Table II several other tables were made to establish the relation of (1) the clinical grouping to: (*a*) the cell type, (*b*) the malignancy index, and (*c*) the clinical result; (2) the cell type to: (*a*) the malig-

nancy index, and (*b*) the clinical result, and (3) the malignancy index to the clinical result. It is apparent that the prognostic value of the histological malignancy index depends entirely on the good clinical results obtained, just as the efficacy of surgical or radiological treatment of cervical carcinomata can be determined only by the end results, that is, anatomic healing at the end of three or five years.

THE RELATION OF THE CLINICAL GROUPING TO THE CELL TYPE, THE HISTOLOGICAL MALIGNANCY INDEX AND THE CLINICAL RESULT

The study of the relation of the extent of the carcinoma, expressed in the Groups 1 to 4, to the cell type, the malignancy index and the clinical result can best be made by tabulating the 60 cases according to the groups. For this purpose the histological malignancy index was divided into four classes, namely, 10 to 20, 21 to 25, 26 to 30, and 31 to 40 (see Table III). If the cases are tabulated according to the groups and then the average of malignancy indices calculated in each group, it is seen that only slight differences in the average malignancy index for each group exist (see Table IIIa). In other words, a relation between group and malignancy index does not exist.

TABLE II

CARCINOMATA OF THE CERVIX WITH KNOWN END RESULTS

1. Protocol number	1	2	3	4	5	6	8	10	12	14	15	16	20	22	24	26	28	29	33	34	36	39	41	42	45	46	47	50	52		
2. Cell type	8	6	6	A6	6	6	4	2	6	4	4	6	4	4	A6	A8	6	8	6	2	A6	4	6	8	A8	8	A4	6	4		
3. Malignancy index	37	27	32	20	25	27	30	22	21	26	20	26	18	25	18	27	28	27	29	12	16	18	24	23	23	33	22	22	17		
4. Group	3	3	R3	R1	3	3	R3	3	3	4	2	3	4	3	3	4	R4	2	4	4	3	3	3	3	3	2	R4	3	3		
5. Clinical result	4	4	4	1	2	2	4	2	1	4	2	2	4	3	3	4	4	4	4	2	1	1	3	2	3	4	4	1	2		
1. Protocol number	58	60	61	62	63	64	65	66	68	71	73	74	76	77	79	80	82	83	84	93	91	94	92	96	97	98	100	107	111		
2. Cell type	8	6	8	6	4	6	6	8	6	A6	A6	6	6	4	6	4	4	6	4	8	2	6	A6	6	6	A6	4	8	6		
3. Malignancy index	22	24	26	25	15	27	18	31	26	19	20	21	27	15	30	25	23	30	25	27	17	22	23	23	11	20	10	29	18		
4. Group	4	3	3	2	2	3	3	3	3	4	2	2	3	3	3	4	2	4	4	4	3	2	1	4	4	1	3	2	R4		
5. Clinical result	4	1	1	1	2	1	1	3	1	4	3	1	3	1	3	3	3	4	3	3	1	1	4	3	2	1	1	3	4		

TABLE III

COMPARISON OF CLINICAL GROUPS TO CELL TYPE, MALIGNANCY INDEX AND CLINICAL RESULTS

	Clinical Group 4							Clinical Group 3										Clinical Group 2			Clinical Group 1		
Cell type	4	2	4	4	A6	6	6	A6	A6	4	4	6	4	2	4	2		4	4	A6	A6	A6	
Malignancy index 10–20	18	12	13	17	19	17	18	18	16	18	17	18	15	17	10	12		20	15	20	20	20	
Clinical result	4	2	4	4	4	2	4	3	1	1	2	1	1	1	1	R4		2	2	3	1	1	
Cell type	4	6	A4	8	4	4	6	2	6	4	6	8	A8	6	6	4		6	6	6	A6		
Malignancy index 21–25	22	22	22	22	25	25	23	22	21	25	24	23	23	22	24	23		21	21	22	23		
Clinical result	4	4	4	4	3	3	3	2	1	3	3	2	2	1	1	2		1	1	1	4		
Cell type	A8	6	6	6	8	8	..	6	6	4	6	8	6	6	6	6		8	8				
Malignancy index 26–30	27	28	29	30	27	30	..	27	27	30	26	26	27	26	27	30		27	29				
Clinical result	4	4	4	4	3	4	..	4	3	4	2	1	1	1	3	3		4	3				
Cell type	A8	..	..	..	..	..	..	8	6	8	..	..	..	..	..	..		8					
Malignancy index 31–40	33	..	..	..	..	..	..	37	32	31	..	..	..	..	..	..		33					
Clinical result	4	..	..	..	..	..	..	4	4	3	..	..	..	..	..	..		4					

Malignancy Index 10–20 Clinical Result 1 obtained in Group 3, 2, and 1 in 14 cases 8 times.
Malignancy Index 21–25 Clinical Result 1 obtained in Group 3, 2 and 1 in 13 cases 6 times.
Malignancy Index 26–30 Clinical Result 1 obtained in Group 3, 2 and 1 in 11 cases 3 times.
Malignancy Index 31–40 Clinical Result 1 obtained in Group 3, 2 and 1 in 4 cases 0 times.
In Clinical Group 4 not a single Clinical Result 1 was obtained irrespective of Malignancy Index.

TABLE IIIa

RELATION OF CLINICAL EXTENT OR GROUPING TO THE MALIGNANCY INDEX

Group 1 showed an average Malignancy Index of 21.0
Group 2 showed an average Malignancy Index of 23.11
Group 3 showed an average Malignancy Index of 23.07
Group 4 showed an average Malignancy Index of 22.81

Therefore all the deductions made in the study of the relation of the malignancy index to the extent of the disease, the cell type and the clinical result are based on the percentages of clinical results obtained at the end of three years.

If the Group 4 cases in Table III are now perused, it is seen that all the Group 4 cases have succumbed to the disease regardless of the cell type or the malignancy index. This coincides with the clinical findings obtained in a series of 183 primary cervical carcinomata treated in our clinic between the years 1914 to 1920 inclusive. In Group 1 were 10 cases with 8 five-year cures, or 80 per cent; in Group 2 were 21 cases with 7 five-year cures, or 33.33 per cent; in Group 3 were 91 cases with 11 five-year cures, or 11.8 per cent; and in Group 4 were 59 cases without any five-year cures. The Group 4 cases are absolutely hopeless from a clinical standpoint regardless of cell type or histological malignancy index. If the clinical result of the Group 4 cases, tabulated in Table III, is studied, it is found that 15 cases had clinical result 4; 4 cases had clinical result 3, and 2 cases had clinical result 2. Not a single case survived a three-year period free and well from the cancer regardless of cell type and malignancy index.

If Groups 1 to 3 are considered in relation to the cell type and clinical result, and the malignancy index and clinical result, then the deduction must be drawn that neither the grouping nor the extent of the disease bears any relation to the cell type and malignancy index. The following tabulations show these deductions at a glance:

RELATION OF GROUPING TO CELL TYPE

	No.	Group 3 Clinical Result 1	No.	Group 2 Clinical Result 1	No.	Group 1 Clinical Result 1	No.	Total Clinical Result 1
Cell Type 2	3	1	0	..	0	..	3	1
Cell Type 4	7	3	2	0	0	..	9	3
Cell Type 6	15	7	4	3	3	2	22	12
Cell Type 8	5	1	3	0	0	..	8	1
Total	30	12	9	3	3	2		

RELATION OF GROUPING TO MALIGNANCY INDEX

Malignancy Index	No.	Group 3 Clinical Result 1	No.	Group 2 Clinical Result 1	No.	Group 1 Clinical Result 1	Clinical Result Per Cent
10–20	9	6	3	0	2	2	50.71
21–25	9	3	3	3	1	0	46.15
26–30	9	3	2	0	0	0	27.27
31–40	3	0	1	0			
Total	30	12 or 40%	9	3 or 33.3%	3	2 or 66.7%	

It is seen that in Group 3 there were 30 cases with 12 good results (clinical result 1), or 40 per cent; in Group 2 were 9 cases with 3 good results, or 33.33 per cent; and in Group 1 were 3 cases with 2 good results or 66.67 per cent. However, 3 cases were of cell type 2 with 1 good result, or 33.33 per cent; 9 cases were of cell type 4 with 3 good results, or 33.33 per cent; 22 cases were of cell type 6 with 12 good results, or 54.17 per cent; and 8 cases were of cell type 8 with 1 good result, or 12.50 per cent.

The cell types in Groups 1 to 3 do not bear any relation to the percentage of clinical results. Cell type 6 shows the highest percentage, which however ought to be found in cell type 2.

Further, 14 cases had a malignancy index of 10 to 20 with 8 good results, or 57.14 per cent; 13 cases had a malignancy index of 21 to 35 with 6 good results, or 46.14 per cent; 11 cases had a malignancy index of 26 to 30 with 3 good results, 27.27 per cent; 4 cases had a malignancy index of 31 to 40 with 0 good results, or 0 per cent.

The malignancy index in Groups 1 to 3 coincides very well with the good results obtained. The lower the malignancy index the higher is the percentage of clinical result 1; while a malignancy index of 31 or higher does not show any clinical result 1.

The conclusions may be drawn that the extent of the carcinoma of the cervix expressed in Groups 1 to 4 has no relation to the cell type and the malignancy index. It influences, however, the clinical result as all the cases of Group 4 have and will continue to succumb to the disease regardless of cell type, malignancy index or method of treatment. Such cancers have become generalized or systemic diseases. Local treatment,—and surgery and radiation treatment are essentially local measures,—cannot have any influence on the eradication or arrest of such extensive growths.

THE RELATION OF THE CELL TYPE TO THE MALIGNANCY INDEX AND THE CLINICAL RESULT

Table IV shows in tabulated form the relation of the cell type of the carcinoma

to the malignancy index and the clinical result. There seems to be a definite relationship between the cell type and the malignancy index. However since all deductions for the prognosis and success of treatment depend solely on the final healing or clinical result 1, it would seem that the cell type alone cannot be depended on for the prognosis of a given case. The fact that cell type 6 shows the highest percentage of good clinical results would lead to the conviction that the malignancy index gives much more information than the cell type alone, which was shown in the preceding paragraph. Table IVa shows the results 1, 2, 3 and 4 obtained in each cell type. Table IVa also corroborates

TABLE IV

RELATION OF CELL TYPE TO MALIGNANCY INDEX AND CLINICAL RESULT

Cell Type	2	4	6	8
Average malignancy index	15.75	20.64	23.52	26.62
Number of cases in each cell type	4	14	29	13
Clinical Result 1 in the cell types, per cent	25	21.43	41.38	6.31

TABLE IVa

RELATION OF CELL TYPE TO CLINICAL RESULTS

Cell Type	2		4		6		8	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Result 1	1	25.00	3	21.43	12	41.38	1	7.69
Result 2	2	50.00	4	28.57	4	13.79	1	7.69
Result 3	..	.....	3	21.43	6	20.69	4	30.76
Result 4	1	25.00	4	21.57	7	24.14	7	53.86

the findings of Table IV, namely the discrepancy existing between cell type and clinical result.

THE RELATION OF THE MALIGNANCY INDEX TO THE CLINICAL RESULT

In the study of the relation of the histological malignancy index to the clinical result we obtain information that is not afforded by the cell type alone. This is especially apparent if the Group 4 cases are omitted. For instance in the clinical result 4 line of Table V were four Group 4 cases with a malignancy index 10 to 20; two Group 4 cases with a malignancy index 21 to 25; seven Group 4 cases with a malignancy index 26 to 30; and one Group 4 case with a malignancy index 31 to 40 (see Table Va).

The omission of the Group 4 cases explains the discrepancies apparent in Table V. A malignancy above 31 is shown to be 75 per cent within the clinical result 4, or the worst prognosis, and a malignancy index below 20 is seen to be 61.54 per cent within the clinical result 1 or best prognosis. A study of these tables demonstrates the influence of the Group 4 cases and the dependability of the malignancy index

TABLE V

RELATION OF MALIGNANCY INDEX TO CLINICAL RESULT

Malignancy Index	10 to 20		21 to 25		26 to 30		31 to 40	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Clinical Result 1	8	42.11	6	30.00	3	17.65		
Clinical Result 2	5	26.30	5	25.00	1	5.88		
Clinical Result 3	2	10.53	6	30.00	4	23.53	1	25.00
Clinical Result 4	4	21.04	3	15.00	9	52.94	3	75.00
Total	19	.....	20	.....	17	.....	4	...

TABLE Va

RELATION OF MALIGNANCY INDEX TO CLINICAL RESULT BUT GROUP 4 CASES ARE OMITTED

Malignancy Index	10 to 20		21 to 25		26 to 30		31 to 40	
	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Clinical Result 1	8	61.54	6	40.00	3	33.33		
Clinical Result 2	3	23.18	5	33.33	1	11.12		
Clinical Result 3	2	15.28	3	20.00	3	33.33	1	25.00
Clinical Result 4	..	.....	1	6.67	2	22.22	3	75.00
Total	13	.....	15	.....	9	.....	4	...

for prognosis and treatment of a given cancer case. This statement is borne out by Table IVa. The relation of the cell type to the clinical result does not show such a proportional percentage. A clinical result in cell type 2 occurred in only 33.33 per cent of the cases, and a result 4 in cell type 8 in only 53.86 per cent. The deduction may be drawn that with an increase in the numerical value of the histological malignancy index the percentages of clinical result 1 or prognosis of treatment become correspondingly decreased. The histological malignancy index gives a much more correct indication of the degree of malignancy than the cell type.

The observations on the malignancy index will be extended to the cases treated before 1922. These cases were subjected to a different technique of radiation therapy and therefore are not considered here.

THE PRACTICAL APPLICATION OF THE MALIGNANCY INDEX IN THE PROGNOSIS AND TREATMENT OF CARCINOMATA OF THE CERVIX UTERI

This will be a simple procedure. The malignancy index is determined by the pathologist. The clinician will group his cases. The Group 4 cases are immediately excluded as they have an absolutely bad prognosis and therefore should be treated palliatively. The carcinomata possessing a malignancy index of 31 or higher also furnish a bad prognosis and probably should be excluded from a treatment that otherwise might promise at least palliation. Carcinomata with a malignancy index of 10 to 20 offer a good prognosis probably in about 60 per cent. Those with a malignancy index of 21 to 25 offer a fair prognosis of about 40 per cent, and those with a malignancy index of 26 to 30 may be benefited in about one-fourth of the cases. Of course, additional observations and above all, a greater number of cases will have to be collected before a final statement can be made. The findings of Martzloff, Broders, and Greenough have all been included in our malignancy index. These investigators found a definite relation between the degree of the histological malignancy and the good clinical results obtained. Therefore it may be assumed that future findings will compare well with those obtained in the 60 cases reported here.

SUMMARY AND CONCLUSIONS

1. The cell types, the differentiation, and the anaplastic changes of carcinomas of the cervix have been studied. They were given a numerical value, the sum representing the histological malignancy index.

2. Immaturity of the cells, a low degree of differentiation and a high degree of anaplastic changes are invariably associated with a high malignancy index.

3. The greater the maturity of the cells, the higher the differentiation and the less the anaplastic changes are, the lower will be the malignancy index.

4. The clinical malignancy of a carcinoma depends solely on the results of treatment obtained, provided the same method of treatment was used in each case. The extent of the carcinoma influences the outcome then only if it has thereby become a systemic or generalized disease (Group 4 cases). A carcinoma contained within a well-defined area and having a low malignancy index offers every hope for a relatively good prognosis.

5. Comparing the histological malignancy index with the clinical findings or grouping of the carcinomas and excepting the Group 4 cases, it is found that a definite relation between the two does not exist.

6. The relation of the cell type to the histological malignancy index is definite as seen from Table IV. The unripe cell type is almost always associated with a high malignancy index.

7. The relation of cell type to the clinical result is not as definite as the relation of the malignancy index to the clinical result. The malignancy index shows a definite or proportionate relation to the result of treatment obtained.

8. Considering the relation of the malignancy index to the clinical result and excluding the Group 4 cases, we may conclude that the pathologist can give definite information as to the degree of malignancy from a histological examination expressed in numbers of the malignancy index, which will enable the clinician to choose those cases of carcinomas which may respond with fair prospects to radiation treatment.

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DISCUSSION

DR. B. F. SCHREINER, Buffalo, N. Y. I am very glad to have heard this paper. Personally I have had no experience with the classification of malignancy based on the histology of the tumor. I feel that there is a difference in the types of tumors that involve the cervix: the infiltrating type and those that exfoliate, as well as those that involve the cervical canal. I believe the results are in direct proportion to the anatomy involved. My results have been about the same as those of Dr. Schmitz. We have had 22 cases of very early cancer of the cervix in which 93 per cent healed. We have lost 2 patients from recurrence of the disease. In Group II we had 54 cases in which we had 57 per cent healing, which has fallen to 40 per cent when speaking of three year healings. In Group III we had 118 cases, in which we obtained about 27 per cent healing. In Group IV it is a question of palliation. Some of the patients lived for three years, but finally they all died of the disease. I am sorry we have had no personal experience with the classification as outlined by Dr. Schmitz.

DR. ROBERT B. GREENOUGH, Boston. I think we must express our gratitude and appreciation to Dr. Schmitz for this extremely painstaking and arduous piece of work. Dr. Schmitz has made this elaborate analysis of his cases in order to present the matter for our consideration. So elaborate a study, however, is not necessary in routine work and it will be sufficient if the surgeon can add to the clinical data a statement from the pathologist as to the degree of differentiation and thus of the potential malignancy of the individual tumor. I believe that such a statement will soon form a necessary and important part of every pathological report on a malignant tumor. It is to be regretted that the low malignancy group in cases of cancer of the cervix forms so small a percentage of the whole. Indeed, such cases can often be recognized before operation by the papillary character of the growth, and probably not more than 5 per cent of the total will fall in this class. The difficulties come in distinguishing the transitional and spindle cell types as they are not often clearly defined and merge one into another in such a way that a very careful study is needed to classify them correctly.

This paper of Dr. Schmitz' has contributed more to an accurate estimate of these factors than anything I have seen up to the present time.

DR. SCHMITZ (closing). In conclusion, I may say that the use of the malignancy index in the treatment of carcinoma is really a simple matter. The index is determined. The extent of the disease is obtained by careful and painstaking physical examinations. Prognosis of treatment is then a simple matter. Of course, the final value cannot be determined until our observations have been carried back to the five-year cases.

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THE INFLUENCE OF BACK-SCATTERING UPON THE SURFACE DOSE IN ROENTGEN-RAY THERAPY*

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DIFFERENT investigations on the influence of back-scattering from the patient or a phantom upon the surface dose have been reported (Friedrich, Glasser, Bachem, Failla, Pfahler and others). The results of the different investigators do not all agree. The measurements are practically always made for relatively hard rays only and are often presented in such form as to be of little practical value to the radiologist.

In an attempt to find the reason for these discrepancies and to overcome some of the disadvantages, we have carried out a number of measurements by means of the Siemens dosimeter.[1] They cover the following points: (1) the change of the surface dose with changes of the size of field, using different qualities of radiation; (2) the amount of radiation scattered back from the water phantom for different sizes of field; (3) the magnitude of the ionization current in a small ivory ionization chamber used in our experiments, and the relation of this ionization current to the physical and biological dose, and (4) the significance of the back-scattering for standardization of the roentgen-ray dose.

The results and their practical value will be presented in the first part of this paper while the measuring apparatus and the experimental procedures with a more theoretical discussion of the results obtained will be given in the second part.

PART I

The actual working conditions were taken from those usually employed in therapeutic practice. The radiation qualities used were of three different types, namely: hard, medium and soft, corresponding to half value layers of 13 mm., 3.5 mm. and 1.75 mm. aluminum respectively. They were produced by the following technique: (1) 200 kv. sphere gap, and 0.5 mm. Cu plus 1 mm. Al filter; (2) 130 kv. and 4 mm. Al; (3) 100 kv. and 1 mm. Al. The focal distance for all measurements was 50 cm. Tests for shorter distances were made down to 35 cm., but the results so far as the questions investigated are concerned were practically the same. The secondary current in all the experiments was 4 ma. The fields used were 20 × 20 cm., 10 × 10 cm., 6 × 8 cm., and 2 × 3 cm.

It has been known[2] for some time that the surface dose has to be increased for a decrease in the size of the port of entry, all the other conditions remaining constant, to produce the same biological effect. Yet this principle has not been generally applied in therapeutic work. Perhaps the reason for this is that the effect on the surface intensity with different sized fields has been under-estimated. The already mentioned discrepancies between the results of determinations of this fact were of little assistance in observing it in actual treatment work. Our measurements showed in the first place that the influence of the size of the field upon the surface dose is very marked even for softer rays. They showed furthermore that all the results of the measurements of this effect depend greatly on the special arrangement of the tube and scattering medium used and that the data on this "field effect" are of value only for the special equipment and arrangement with which they have been determined. A discussion of this latter question and its significance upon some important dosage questions will be taken up later. We believe, however, that it is advisable to present the results of the determination of the field effect on our special equipment (see Table 1), since they may be nearly duplicated as long as a similar treatment arrangement is used.

The first column of Table 1 contains the various sized fields used. The next three

* From the Metcalf Foundation for Deep Therapy, Orange, N. J.

columns show for the three qualities of radiation used, the factor for each of the various sized fields by which the time known to produce a certain reaction for a large field (20 × 20 cm.) has to be multiplied to obtain the time for producing the reaction when using a smaller field. To obtain the factors for intermediate fields, different from those in our measurements, a graphic representation of the data is given in Figure 1.

TABLE I

Size of Field in Cm.	Radiation Qualities Quality 1 (Hard)	Quality 2 (Medium)	Quality 3 (Soft)
20 × 20	1.0	1.0	1.0
10 × 15	1.05	1.05	1.03
10 × 10	1.12	1.08	1.06
6 × 8	1.24	1.16	1.09
2 × 3	1.80	1.41	1.27

Radiation quality 1 (hard) produced with 200 kv. and 0.5 mm. Cu plus 1 mm. Al; 2 (medium) produced with 130 kv. and 4 mm. Al; 3 (soft) produced with 100 kv. and 1 mm. Al.

From a study of the results given in the table and the diagram, it is evident that the influence of the size of field upon the time of treatment is considerable and must be taken into consideration for proper dosage. If, for instance, a small lesion has to be treated by a 2 × 3 cm. field using a voltage of 130 kv. and 4 mm. Al filter, 50 cm. focal distance and 4 ma., and the dose for a large field is known to be 20 minutes, then to get the same reaction the dose would have to be multiplied by the factor 1.41. The treatment time then would be 28 minutes, i.e., for the large field would have to be increased by 41 per cent. In the same way, the treatment times for other conditions can be computed.

It is well known from the fundamental investigations of Kroenig and Friedrich[2] that this "field effect" is due to the influence of scattering in the tissue upon the surface intensity. That part of the scattering to which the change in the surface intensity with different sizes of field is due, the so-called "back-scattering," was determined for our special technique and conditions used. Here again it must be stated that this amount of back-scattering from the human body or water depends entirely upon the special treatment arrangement used as well as upon the size of the patient and location of area to be treated. In special experiments we also found that the "field effect" as presented in Table 1 and Figure 1 is due not only to the back-scattering of the water but partly also to the back-scattering of the treatment table. Furthermore, the special type of measuring instrument used may have some influence upon the amount of back-scattering measured. Consequently the data on the backscattering given in Table II again are presented as landmarks which may be reproduced exactly only if a similar technique and treatment arrangement is used. They have been determined by measuring and then calculating the difference of the intensities with the water phantom both with intensity present on the surface of the water or on the human skin.

TABLE II

Size of Field in Cm.	Quality 1 (Hard) Per Cent	Quality 2 (Medium) Per Cent	Quality 3 (Soft) Per Cent
20 × 20	52	32	17
10 × 15	48	29	15
10 × 10	44	25	13
6 × 8	36	20	10
2 × 3	13	7	4

These results agree fairly well with measurements made by one of us, together with Friedrich[3] several years ago; they disagree, however, with some data reported more recently, but the reason for this disagreement can easily be traced to one of the difficulties of measurements as enumerated above. Some data of the back-scattering reported by Grebe and Martius,[4] however, are far higher than reported by any one else so that some principal difference in the method of measuring this effect must have been present. Possibly the so-called "direction effect" has something to do with this high back-scattering. The "direction effect" in the chamber of the Siemens dosimeter was investigated by us and found to be possibly as high as 10 per cent. Yet it would hardly have an influence on our reading of the back-scattering. Since Grebe and Martius draw certain important conclusions from their observations of this high back-scattering as regards the standardization of the roentgen dose, we will have to come back to a discussion of this point.

A large number of determinations of the back-scattering from the patient for given

treatment conditions (Quality 1, 50 cm. F.S.D. large opening) were also made to determine the difference in this effect for constant treatment conditions but different sized scattering media. For the conditions stated the back-scattering on the water phantom was found to be 52 per cent, whereas on different patients it was from 40 to 70 per cent. While, for the most part, the higher back-scattering could be attributed to an increased thickness of the patient, yet there appeared to be a number of variations which could not easily be explained. They are believed to be due to the difference in the back-scattering of the different organs in the body, i.e., the amount of gas in the intestines, urine in the bladder, size and density of the tumor, etc.

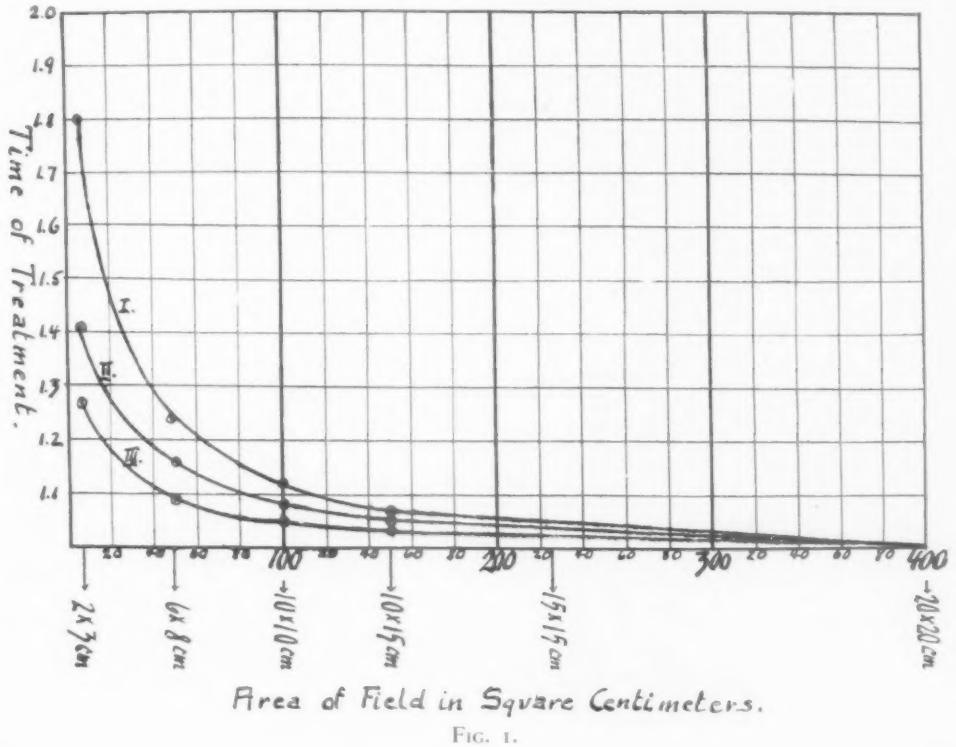

FIG. 1.

PART II

HIGH TENSION APPARATUS AND TECHNIQUE OF MEASUREMENTS

The high tension apparatus used was the Neo-Intensiv apparatus of the Veifa works. This is a transformer apparatus with mechanical rectification (needle). Two condensers of a capacity of about 2.5×10^{-8} farad are connected in parallel with the roentgen tube to smooth out the mechanically rectified current curve, thus producing practically a high tension direct current. In this way the intensity delivered from the tube is increased approximately 35 per cent as has been shown by ionization measurements with the condensers connected with and disconnected from the tube, keeping all other conditions constant. A Coolidge tube with tungsten target was used for all the measurements.

Most of the measurements were made with the Siemens roentgen dosimeter. A short description of this instrument was given in this Journal by one of us several years ago.[5] The instrument has three units as illustrated in Figure 2. The first unit consists of the water phantom and small ivory ionization chamber (1), the second unit of a high ohm resistance and an amplifier tube (2), and the third unit of a switchboard (4) containing the A- and B-batteries, the control resistances and the

indicating meters, and recording meter (3). We do not wish to go into a detailed description of the instrument and we refer the reader to the schematic diagram (Fig. 3) taken from one of the numerous publications of it.[1, 6] The main working principle, however, is as follows: The ionization current of the small ionization chamber is conducted over a high ohm resistance, on the ends (a, b) of which a tension is produced which is proportional to the resistance itself as well as to the ionization current. By proper selection of the resistance, the sensitivity of the whole measuring arrangement can be chosen to suit the requirements. This potential difference, then, is impressed upon the grid of the audion tube. In this way it is possible to amplify the small ionization current of the chamber about 100,000 times, that is, to such a strength that its value can be read on a technical pointer instrument and even recorded on a recording instrument.

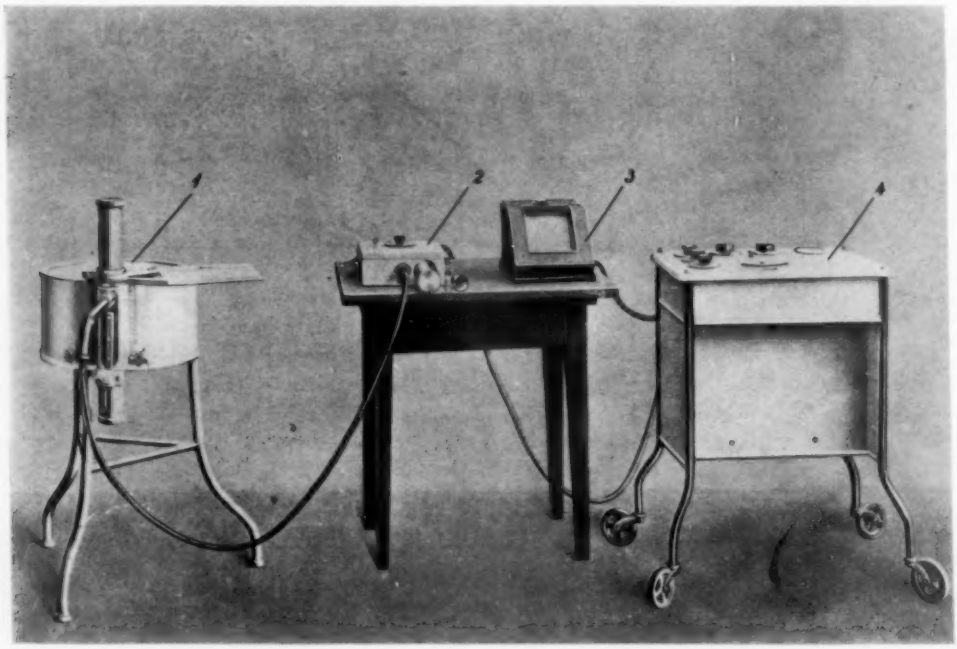

FIG. 2. Siemens roentgen dosimeter. 1. Water phantom with ionization chamber. 2. Box with high ohm resistance, amplifier tube and uranium oxide chamber. 3. Recording galvanometer. 4. Switch-board with A- and B-batteries, controls and meters.

The advantages of the dose measurements with this instrument are according to Grossmann[6] the following: (1) The dose per second is read from the stationary deflection of a pointer instrument (similar to a milliammeter). Therefore a large number of dose determinations can be made in a short time. The rapidity of the measurements is especially valuable if the line voltage fluctuates. (2) The dose per second can be read during the complete time of radiation or it even can be recorded by a recording galvanometer. (3) The reading of the deflection on this instrument can be done far away from the roentgen-ray tube. (4) Determination of the intensities in a water phantom as well as in body cavities can be made. (5) A standard uranium oxide chamber can be connected to the audion tube instead of the small chamber and thus the constancy of the apparatus can be controlled.

Practically all of our measurements were carried out with this instrument. The small ionization chamber was half submerged and always in the same position. The inside dimensions of the round water phantom are: diameter, 40 cm. and height, 20 cm.

The voltages at the tube for the three different conditions of radiation quality used were ascertained by sphere gap read-

ings according to the specifications of the American Institute of Electrical Engineers. These readings were controlled by studies of the minimum wave length of spectra taken at the different voltages with a Seemann spectrograph. The practical roentgenologist, however, is more interested in the average quality of the radiation beam used, and for this reason we also determined the half value layers in millimeters of aluminum for the three qualities. This was done by absorption measurements with the Dessauer electroscope. This instrument has a large ionization chamber and carbon electrodes, and lends itself better to the exact determination of absorption curves than the small ionization chamber because the influence of scattering is less

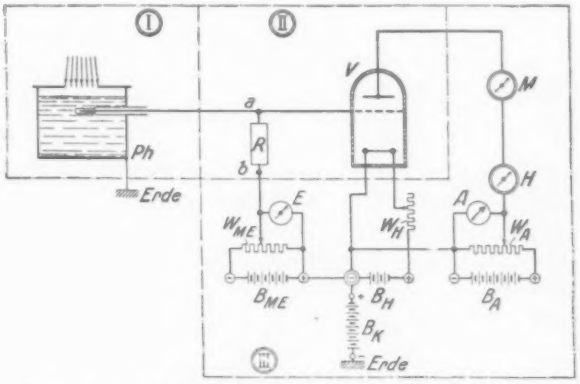

Fig. 3. Schematic diagram of Siemens roentgen dosimeter.

I. Water phantom (Ph) with small ionization chamber submerged. Ground: E.

II. Resistance (R) and amplifier tube (V).

III. Indicating meters (M, H, A, E), control units (W_{ME}, W_H, W_A) and batteries (B_{ME}, B_H, B_A).

marked when using a fine roentgen-ray pencil for the measurements. The half value layers taken from the complete absorption curves in aluminum have been given above.

The Siemens dosimeter permits also the determination of the ionization current in the small ionization chamber for given radiation conditions by means of comparison of it with the current in the standard uranium chamber. This is perhaps best illustrated by an example of our reading: For radiation quality 1 (hard), i.e., 200 kv. and 0.5 mm. Cu and 1 mm. Al filter, 4 ma., a focal distance of 50 cm. and a large opening of 20 × 20 cm., the deflection of the galvanometer was 0.73 if resistance 2 in the audion box was used (see Figs. 2 and 3). If for the same conditions the standard uranium oxide chamber is connected to the system the deflection is 0.38. According to the calibration data of this standard chamber by Siemens and Halske the ionization current in this chamber corresponds to 2.22×10^{-10} amperes. Consequently, the ionization current in the small ivory chamber produced by radiation quality 1, when using the technique mentioned is $2.22 \times 10^{-10} \times 0.73/0.38$ or 4.27×10^{-10} ampere.

Fig. 4. Ivory ionization chamber.

We tried to draw conclusions from this current in regard to doses in "Roentgen (or electrostatic) units." This, however, was not possible with the required accuracy on account of the fact that the effective atomic number of the ivory, which forms the wall material of the ionization chamber, is different from that of atmospheric air, and furthermore on account of the fact that it is very hard to determine exactly the active air volume of the ionization chamber; a roentgenogram of the chamber may illustrate this latter difficulty (Fig. 4). The comparison of the currents in the ionization chamber with the electrostatic units was carried through in such a way that they were compared directly with the readings in a small "artificial air chamber"[7] calibrated in Roentgen units, connected to a Wulf string electrometer. For the radia-

tion conditions mentioned the number of R-units per second were 0.3, 0.22 and 0.21R for the qualities 1, 2, and 3 respectively, measured directly on the surface of the water phantom.

Experiments to compute from the ionization currents in the ivory chamber directly the Roentgen units will be continued and a report will follow.

It may be added here that the erythema doses were determined in R-units directly on the skin of a large number of patients for the three radiation qualities and that they are in close agreement with the doses reported in another publication,[8] namely, 1300 R-units for quality 1, 700 R-units for quality 2, and 450 R-units for quality 3; this brings the erythema time for the technique used to 72 min., 53 min., and 36 min. respectively. The procedure of arriving at the unit doses physically and biologically has been described in detail.[9]

These latter considerations lead us over to the important problem of the standardization of the roentgen-ray dose, a problem which now is under investigation in many quarters. As far as the standardization of the radiation dose in absolute electrostatic units is concerned, there are two different procedures to settle this part of the problem. Some of the reports (Beets and Arens,[10] Grebe and Martius,[11] and others) recommend the determination of the primary intensity of the radiation in air, i.e., without a scattering medium, while others (Friedrich,[2] Bachem,[12] and Glasser[8]) recommend the determination of the surface intensity directly on the patient or a water phantom. Our measurements on the influence of the back-scattering upon the surface dose have shown that both of these methods have to be combined in the proper way to come to a solution of the whole problem. We mentioned above that the back-scattering depends very much upon the special treatment arrangement used. We have carried through, as already stated, for the hard rays (quality 1) and the largest and smallest openings for the technique mentioned, a number of special experiments to determine the influence of our special treatment arrangement. In Table 1 the time factor for the smallest field 2×3 cm. in relation to the largest when using the water phantom was 1.80. If we determine for the same conditions this factor for the empty phantom, we still measure a factor of 1.23 which shows that for the wide opening a large amount of the back-scattering is due to the walls of the phantom (lead and steel) in addition to the back-scattering of the water. For the same radiation conditions we also found a factor of 1.20, even if the phantom was removed entirely and the ionization chamber freely suspended in air. Here the 20 per cent is due to the back-scattering of the wooden floor of the room where the area irradiated is rather large due to the long distance of the tube and the diaphragm from the floor. If we leave the chamber in the same position but bring under it the treatment table arranged as it is used for the actual treatment (but without patient) the factor goes up to 1.32, i.e., even higher than for the scattering walls of the phantom. Here the back-scattering is due mostly to the wooden plate of the table.

These uncertain conditions as to the back-scattering give an indirect answer to the calibration questions cited above. To measure, for instance, the comparative intensities of different tubes on one machine or of tubes on different machines, it is advisable to place the chamber in the open air, i.e., without scattering medium, unless one is absolutely sure that the scattering arrangement for which the check has been made once is exactly reproduced.

The best suggestion in this connection has recently been made by Holthusen.[13] To compare roentgen-ray intensities delivered by different machines, different tubes, etc., Holthusen introduces the "roentgen value" and defines it in the following way: "The roentgen value is the number of R-units which the radiation delivers per minute at a focal distance of 30 cm. without additional scattered radiation." This suggestion is a very valuable one for the problem of standardization, and its general use can be strongly recommended. For the radiation conditions in this country, it is perhaps advisable to measure the roentgen value at a distance of 50 cm. from the focus since the dimensions of a number of tube shields on the market will not permit measurements to be made at 30 cm. dis-

tance. The roentgen value for our three radiation qualities at a distance of 50 cm. are 10.8, 10.0, 11.8 R/min.

The step from these surface intensity measurements to the actual surface dose on the skin of a patient is, however, a long one and even carefully worked out tables for the back-scattering under different conditions (such as for instance Table 1) are not applicable in all cases, since, as mentioned several times, the amount of the back-scattering depends greatly upon the treatment arrangement used, as well as upon the size and radiation area of the patient under treatment. Therefore the connection of the biological effect on the skin with the surface intensities can be found only by measurements taken directly on the skin of a large number of patients.[9] An erythema dose in any units, for instance R-units, has to be measured there where the erythema is produced. We have done this on a large number of cases and found the number of R-units given above.

SUMMARY

1. The influence of back-scattering from the patient or from a water phantom upon the surface dose was investigated.

2. This influence varies markedly with the particular treatment arrangement used, as well as with the thickness of the patient and the area treated.

3. The ionization current in a small ivory ionization chamber was determined in amperes for the radiation conditions used in deep therapy.

4. The erythema doses for different radiation qualities was determined in R-units.

5. Experiments showed that it is advisable when calibrating different machines, different tubes, etc., to have the ionization chamber freely suspended in air. The use of the "roentgen value" as expressed by Holthusen is strongly recommended. To measure erythema doses, however, the chamber ought to be placed there where the erythema is produced, i.e., on the skin of the patient. All biological doses therefore ought to be measured and indicated in the latter way.

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RUSSELL D. CARMAN

1875–1926

EDITORIALS

CARMAN
1875–1926

ONE evening late in September of last year a stalwart man boarded a westbound train in the city of Washington. As he strode down the aisle of the car the passengers looked up to study the newcomer. With his six feet of sturdy frame clothed in mighty muscles, a ruddy skin, gray eyes set well apart, silvered temples, firm jaw and mobile mouth, this man, they thought, must be a senator or a high official. He was neither. He was Russell D. Carman, doctor of medicine, head of the section of roentgenology in the Mayo Clinic, and he had just been elected president of the American Roentgen Ray Society, a coveted and crowning honor. With his wife he had spent a delightful summer in Europe, attending the International Congress of Radiology and touring the Continent. In all his fifty years no bitter grief, no blasting ill, had been his lot. Fame had come to him, and fortune had been kind. Now he was going home to take up the daily work he loved, and to hear from his comrades their applause, tempered with corrective gibes, on this his latest triumph. Life was sweet to him, and the car wheels sang a song of jubilation.

As the train neared Rochester he suffered a gastric upset. Evidently, his gallbladder, which had been drained twelve years before for stones, was making trouble again. Often there had been some distress, but this attack was most vexatious. That gallbladder was becoming too annoying; he must arrange to have it out. Still, drainage with the duodenal tube might give relief.

Once home, the tube was used. It brought a show of blood. Carman's interest, partly personal, partly professional, was increased. There might also be a small ulcer. He would be examined with the *x*-ray. He smiled to think of taking the passive rôle, of being "hoist with his own petard."

October 8th he stood gayly before the screen where thousands of patients had confronted him. In the darkness the *x*-ray tube gave out its steady drone. No other sound was heard, for his associates were dumb as they gazed at a distorted gastric shadow. Finally they found voice. Spasm, they told him, evasively. They would make some films.

Carman returned to his office. It was a gray afternoon. On his desk was the rough draft of a new paper on cancer of the stomach. It had been the theme of the first paper he published from Rochester. When the films were ready his assistants could not withhold them. Gravely they were laid before the Chief. Holding them toward the window he passed unbiased judgment. "Cancer of the stomach and inoperable," he said. Fellow members of the staff gathered. To them he pointed out the tell-tale marks he knew so well. He was flushed, but only with animation. Despair peered in, but paused on the threshold. Carman's colleagues left the room. Then his eyes grew moist. "If I could have lived only ten years more—," he said. A few minutes later he sat in the film-room dictating diagnoses, as of old. Before he had quite finished he rose suddenly and went out. It was his last day of set routine.

Followed then the hopes and dreads in turn, the brighter views held out by friends who all but duped themselves in their desire to give him cheer, the new trial with the *x*-ray which seemed to hint a chance of help from surgery; the exploration which confirmed the first opinion, and the palliative operation to prolong his life. Recovery from the operation was rapid. For a time he seemed really better than before. Then the slow, inexorable decline. The square shoulders began to droop; the great muscles slowly wasted; only the clear mind remained unharmed to ponder this

disaster. The end came June 17th. His body lies in Oakwood Cemetery at Rochester.

Russell Daniel Carman, son of Edwin H. and Sarah Carman, was born at Iroquois, Ontario, March 18, 1875. At the age of seventeen he came with his mother to Butte, later to St. Paul. After some preliminary study in Minneapolis Academy he took the first two years of the medical course in the University of Minnesota. Removing then to St. Louis he completed his course in the Marion-Sims College of Medicine, receiving the degree of M.D. in 1901. For a year he did graduate work at Johns Hopkins Medical School and returned to St. Louis to practice. At first he planned to take up orthopedics, but, having a natural bent for the electrical arts, he was soon attracted to medical roentgenology, which was then in its early stages of development. Keeping pace with its advances and devoting himself assiduously to the work, he soon became known as an exceedingly proficient and unusually reliable roentgenologist. He was made professor of roentgenology in the medical school of St. Louis University and resigned later to accept the same post in Washington University. On invitation, he joined the staff of the Mayo Clinic, January 1, 1913, as head of the section on roentgenology, and continued in that capacity until his death.

At the time when Carman came to the Clinic, the diagnosis of gastrointestinal disease with the *x*-ray was in its infancy. Some progress had been made abroad, but in America scant attention was being given to the method. Sensing its possibilities, Carman applied himself intensively to its employment. A prime reason for his coming to the Clinic was the fact that here he would have the opportunity of following his gastrointestinal cases to operation and comparing the roentgenologic and operative findings. Only proof of this sort would satisfy Carman. Alert for all that was new, he nevertheless maintained a wholesome skepticism. He was a practical man and had little patience for elaborate theories. The shadows that lend themselves so readily to deception seldom deceived Carman. He saw them in all their detail, but his deductions were brief and safe. A strong partisan of fluoroscopy, he became remarkably adept with the screen. The rapidity of his examinations and the accuracy of his diagnoses were amazing to casual visitors.

Carman held membership in many medical and roentgenological societies. He participated actively in their proceedings, and was in frequent request to address other organizations. Everywhere he preached the simple gospels of the *x*-ray. More than any other man, he contributed toward bringing the roentgenologic examination of the digestive tract into general employment. The younger roentgenologists who were his personal pupils take pride in their distinguished tutelage.

The self of Carman had many sides. A host of men knew much of him, but no man knew all; no man can picture him just as others saw him. Open frankness and close reserve, burning zeal and cold indifference, easy pliancy and unyielding resolve, fear of strife and rare courage in his losing fight for life, high exaltation and low depression—these were some of the warring traits that make a static sketch imperfect. They were the changing, fluid qualities of Carman the boy—the baffling, vexing, lovable boy.

More important were his solid, constant attributes: extraordinary keenness of observation; abundant common sense; conservative, trustworthy, professional judgment; unflagging industry coupled with a marvelous capacity for work; an eager wish for the truth, the whole truth and nothing but the truth in his chosen field. These were characteristics of Carman the man, the roentgenologist, which earned him leadership. Outstanding, too, was his warm goodwill toward men, his hearty friendliness. To hundreds he was Russell; to him they were Art and Bob and Bill. Thus great personal charm helped to make his talents recognized.

The world of the *x*-ray has lost a master workman. For a time it will grieve that he is dead. For a longer time it will rejoice that he lived.

In his last will, Carman commanded that when his wife and mother shall no longer need the use of his estate, it shall pass to the institution he so proudly

served, to endow fellowships in roentgenology. If from these fellowships there shall some day arise another roentgenologist of wondrous skill and wide renown, the soul of Carman will be content.

ALBERT MILLER.

EXUDATIVE IRITIS

New developments in roentgenotherapy of late years have been mainly along the lines of deep therapy in keeping with the ever-increasing interest in an effort to combat our greatest unsolved medical problem, malignancy. The progress made along these lines, while most valuable and necessary, should not lead us in any way to neglect the application of our special means of therapy in other fields, possibly of less general interest but none the less equally important.

The roentgen ray has been a valuable aid to the opthalmologist for many years in a diagnostic way, helping to explain the etiology of many conditions met with in this special field. The aid given him in the matter of sources of focal infection in the teeth and sinuses has been almost as valuable as that rendered the nose and throat specialist. The recognition of the presence of tumors affecting the eyes has been greatly advanced by careful roentgen-ray study, and the exact determination of the presence and location of opaque foreign bodies has been of extreme value. But our assistance in therapy has been rather meager, largely confined to the treatment of tumors related to the eyes.

For this reason it is felt that any possible extension of the field of roentgen therapy to the sphere of the opthalmologist merits the most careful attention and consideration, especially as, in the present instance, where the treatment of a relatively frequent condition is concerned, namely iritis of the exudative type. Although this use of the roentgen ray is only now being presented to the profession, experience with it dates back about seven years. The hesitancy in calling attention previously to this application has been due principally to the slowness with which experience has been accumulated and the desire to find the results duplicated by the work of some other roentgenologists. This has been attained and the method is offered as a most valuable aid in the treatment of a rather stubborn and difficult condition. It is not presumed to say that all cases will yield to it nor that it is the only satisfactory treatment, but it is the belief that it will greatly hasten the recovery of such cases. The technique is very simple, consisting in small stimulative doses over the affected eye or eyes, with the following factors; spark gap 5 inches; milliamperes 5; distance 20 inches; time 30 seconds; filtration 1 millimeter of aluminum. The total of this exposure, it will be noted, is not very different from that employed in roentgenography of the skull and it was, in fact, incidental to the examination of a patient suffering with such an iritis that the marked and prompt improvement was noted and attention first directed to the possibilities of such therapy.

A clinical report made before the Boston Medical and Surgical Society in 1907 spoke of the marked relief of pain resulting from an application of the roentgen ray in the localization of a foreign body. This reference is apparently the only previous mention made in any publication. The present writer's technique and results are comprised in a paper which was read in the Radiological Section of the American Medical Association at its recent meeting in Dallas, Texas, and which will probably be published in the Journal of the American Medical Association.

ERNEST CHARLES SAMUEL, M.D.

ABSTRACTS OF ARTICLES ON EPIPHYSITIS

In this number of the Journal, in the abstract section, are published a collection of abstracts of articles on epiphysitis, including the following conditions: Vertebral epiphysitis, Schlatter's disease, Köhler's disease of the tarsal scaphoid, Köhler's disease of the second metatarsus, epiphysitis of the os calcis, and osteochondritis dissecans of König. Attention is called to the editorial on this subject in the June number of the Journal and to the abstracts on osteochondritis deformans juvenilis coxae, published in the abstract department of that number.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES

WE contemplate the publication of a list of roentgen society meetings such as that below, in each issue of the Journal, gradually adding other home and foreign societies as the information reaches us. Secretaries of societies not here listed are requested to send the necessary information to the editor.

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Charles L. Martin, Dallas, Texas.
Twenty-Eighth annual meeting, to be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Washington, D. C., 1927.

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Annual meeting, Milwaukee, Wis., Nov. 29–Dec. 3, 1926.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. Sherwood Moore, St. Louis, Mo.
Annual meeting, Atlanta, Georgia, Nov. 15–18, 1926.

THE CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Edward S. Blaine, 5 S. Wabash Ave.
Meets monthly on second Friday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. E. P. McNamee.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. Henry L. Ulbrich, 1130 E. Grand Blvd.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

THE NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Charles W. Blackett, 35 Bay State, Rd., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Eugene V. Powell, 217 East 42d St.
Meets monthly on second Monday, New York Academy of Medicine.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. S. C. Davidson, Highland Hospital.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Davis Spangler, Dallas, Texas.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.
Meets at Dunedin, New Zealand, during February, 1927.

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

THE BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London; W. 1.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prag, II/52.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Torino, Torino.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medcine, 1 Wimpole St., London, W. 1.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Meets in Copenhagen.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

REPORT OF THE STANDARDIZATION COMMITTEE OF THE AMERICAN RADIUM SOCIETY*

The science and art of radium therapy are still in a state of flux. Hence any attempt at a systematic standardization is fraught with insuperable difficulties at this time. Furthermore, premature standardization is likely to do more harm than good. In view of these considerations, in the present report we shall not make categorical recommendations which might require serious modifications in the near future, but we shall make some suggestions which we feel will pave the way for successful standardization at the proper time.

The radiologist is chiefly concerned in the correlation of the "dose of radiation" and the "biological effect" it produces. In order to do this he must have a quantitative measure of the "dose" and a definite knowledge of the "effect." Since all the members of this committee are physicists, we can deal only with the first part of the problem, at this time.

Without giving elaborate details, we shall state that the dose of radiation delivered to a given point in the irradiated tissue is completely defined when we specify (1) the intensity of radiation; (2) the quality of the radiation at the point in question, and (3) the duration of the irradiation. Of course, to correlate the dose and the result produced *as a whole*, it is necessary to know the distribution of the dose from point to point in the tissue treated.

This apparently simple system of dosage is in reality impossible of accomplishment in practice. Of the three factors involved, only one—the duration of the irradiation—can be established accurately by the radiologist. Our present knowledge is not sufficient, in general, to specify accurately the intensity and the quality of the radiation delivered to every point of the irradiated tissue. Accordingly we must resort to more indirect means of specifying a dose.

As already stated, the correlation of dose and effect is needed by the radiologist in order that he may make intelligent use of information derived from the treatment of patients. The better he is able to make this correlation, the simpler it will be for him to analyze the good and bad results, and use the data thus obtained in his future work. The three dosage factors enumerated above, or others equivalent thereto, are essential for this purpose. Hence we must bear in mind that the practical system of dosage we are seeking must include these three factors, at least implicitly. In other words, sufficient dosage data should be given to make it possible at any future time to evaluate the dose of radiation delivered to every point of the irradiated tissue.

It is the opinion of this committee that to accomplish this purpose the following data should be given for each treatment:

1. Location of tumor. (This is of importance only when large pack treatments

* Presented before the Eleventh Annual Meeting, American Radium Society, Dallas, Texas, April 19 and 20, 1926.

are given, in order that the effect of scattering may be included in the depth doses.)

2. General shape of tumor, and dimensions in centimeters, measured or estimated as accurately as possible The use of calipers is highly desirable for this purpose.
   Necessary dimensions:
   (*a*) For approximately spherical tumors, the diameter.
   (*b*) For walnut-shaped and tangerine-shaped tumors, the major and minor diameters.
   (*c*) For almond-shaped tumors, three diameters.
   (*d*) For flat circular tumors, diameter and thickness.
   (*e*) For flat elliptical tumors, major and minor diameters and thickness.
   (*f*) For tumors of irregular shape a sketch should be made on the chart and as many dimensions as necessary should be recorded thereon.
   In some institutions rubber stamps are used to affix to the patient's chart a conventional diagram of the part involved. On this is then outlined the tumor in its proper relative position, and the necessary dimensions are also recorded. This practice is highly recommended.
3. For tumors which do not extend to the surface, the thickness of intervening normal tissue should also be given.
4. The strength of the radioactive source in milligrams of radium element, if a radium salt is used. If radon (radium emanation) is employed, the amount at the beginning of the treatment should be specified in millicuries.
5. Distribution of the radioactive source.
   (*a*) If an applicator is used its construction, shape and dimensions should be given. It should be noted that when radium or radon tubes are used to build up an applicator, it is important to obtain as even a distribution of the radioactive material over the surface of the applicator as is practically possible, unless otherwise desired for special purposes. The effective area should be considered to be only slightly greater than that which is actually covered by the array of tubes. Thus, if the tubes are arranged in a rectangular pattern within a round brass tray, the applicator should be considered to be rectangular and not round, and the dimensions should be recorded accordingly.
   (*b*) When a tube or needle is used, its diameter and effective length should be stated. The radiologist should ascertain the distribution of the radioactive material in the tube or needle, since in some cases the radium salt may be crowded at one end. In this case the effective length would be considerably less than the length of the tube or needle. A dental roentgen-ray film can be used conveniently for this purpose, the outside length of the tube or needle being marked on the film by pin holes. Since ordinary butter is decolorized by radium rays, the active part of the tube or needle may be determined by sinking it into a block of butter (parallel to and just below the surface) and leaving it in place until the decolorization is visible. (A long exposure is necessary for weak tubes.)
6. Filtration. All materials between the radioactive substance and the tissue to be treated act as filters and should be definitely specified. The radiologist should ascertain how his tubes, needles, and plaques have been put up by the manufacturer, stating the material used as filter and its thickness. If additional filters are used they should be specified in a similar manner. Secondary filters such as rubber, leather, or paraffin, should be included in the specification of the total filtration.

   In the case of plaques used for superficial skin lesions, where little filtration is used, it is particularly important to state how they are constructed. There may be a considerable difference in the amount of radiation emitted by two plaques of the same strength but different construction. Perhaps later it will be possible for the Bureau of Standards to determine the equivalent filtration of

such plaques and to include this information in their certificate.

For gamma ray therapy the metallic filter should be 2.0 mm. of brass, or its equivalent, *viz.*, 0.9 mm. of lead, or 1.1 mm. of sterling silver, or 0.5 mm. of platinum or *pure* gold. Two metals may be combined to give this equivalent filtration. A common arrangement is to use 0.5 mm. of sterling silver and 1.0 mm. of brass.

7. Distance. This is one of the most important factors which influence the dose of radiation delivered to the tissues. It is also the factor from which the greatest uncertainty may arise, on account of the fact that, in general, radium applicators are placed close to the tissues.
   (*a*) In view of the difference in the size of tubes which are employed in practice, it is preferable to measure the distance from the center of the source to the surface of the tissue. This applies whether a single tube or a combination of tubes in a "pack" or other applicator is used. To avoid misunderstandings it should be clearly stated in the records that the distance is measured from the center of the radioactive source. (As previously stated 0.5 mm. of platinum and 2.0 mm. of brass give practically the same filtration. If a bore of one millimeter is required to contain a certain amount of radium, the platinum tube would have an outside diameter of 2 mm., whereas the brass tube would be 5 mm. When these two tubes of equal radium content are left *in contact* with the skin for the same length of time, the smaller one will produce the greater surface effect because the source is considerably closer to the skin.*)
   (*b*) In the case of plaques in which the radium is incorporated in a glaze or varnish, or other material it is preferable to measure the distance from the surface. Aside from the effect of filtration, the thickness of the layer which contains the radioactive material affects the intensity of radiation at the surface, and points beyond. Therefore a statement of the construction of the plaque is also important in this connection.
   (*c*) When the source of radiation in the form of needles, "seeds" or "implants" is placed within the tissue, it is important to state the spacing. This should include the distance between adjacent sources, the distance from the assumed border of the tumor and the distribution within the tumor mass. Here again a sketch of the lesion with the position of the needles or implants is highly desirable.

   It is hardly necessary to add that the number of needles or implants used and the strength of each should be recorded. If the sources are of essentially the same value, the number and average strength suffice. Other data pertaining to the size of the needles or implants and the distribution of the radioactive material should be included also.
   (*d*) When a tumor is irradiated from different directions, the location of the sources with distances, etc., should be indicated as clearly as possible, by means of diagrams or otherwise.
8. Duration of irradiation. Every time that radium is applied the duration of the exposure should be recorded separately. If repeated treatments are given, the dates, of course, should be recorded also. It is not desirable to combine the amount of radium and the time of exposure into one factor and express it in milligram-hours. If this is done, the time factor of the treatment does not appear in the records and unjustified comparisons may be made. Thus 100 mg-hr. may be obtained by one radiologist by using 1 mg. of radium for 100 hours and by another radiologist by using 100 mg. for one hour. Assuming that all other conditions are the same in the two instances, the biological effect will probably be different on account of the great difference in the time of exposure.

* The secondary beta radiation is also quite different.

In this connection it may be well to point out also that the term milligram-hours has caused a great deal of confusion in radium therapy. In many publications doses are given simply by stating the milligram-hours and the type of applicator used. This information is utterly inadequate to convey to the reader a fairly accurate idea of the dose of radiation actually delivered to the tissues. Hence the scientific value of the contribution is greatly and needlessly lessened by the omission of important dosage factors.

There is a very reasonable explanation for the prevalence of incomplete dosage data in clinical papers, in that the radiologist who has a certain number of applicators at his disposal, can prescribe a treatment in his office or hospital by simply stating the type of applicator and the milligram-hours to be given. However on account of the great variety of tubes, needles, plaques, and applicators of all sorts, which are used by different radiologists throughout the world, this information is insufficient for a comparison of treatments given by different radiologists. On account of the great importance which this has on the progress of radium therapy, the committee takes the liberty to suggest that the American Radium Society use its influence towards insuring the inclusion of the necessary dosage data in radiological publications.

To recapitulate, we may say that the dosage factors which are required for the evaluation of the dose of radiation delivered to a tissue are:

1. Location of tumor.
2. Size of tumor.
3. Depth of tumor.
4. Strength of radioactive source.
5. Distribution of radioactive source.
6. Filtration.
7. Distance or spacing.
8. Duration of irradiation.

Of these the first three would be given in any event for other reasons. The strength of the source (4), and the duration of irradiation (8) at present are generally combined into one as milligram-hours or millicurie-hours. It is desirable to express the two separately so that the time element of the dose may be definitely stated. The remaining three factors (5), (6), and (7) are often either omitted or imperfectly stated. Of these the filtration, (6), and the distance or spacing, (7), are extremely important.

It is not the intention of this committee to recommend that all the dosage data outlined above should be specified pedantically every time that a given treatment is referred to. For purposes of record in the office or in the hospital it is unnecessary to state repeatedly all of the eight factors given above. If the same applicator or technique is employed a number of times, it is only necessary to describe it fully once and simply refer to it subsequently, mentioning any variations which have been introduced. The important point to bear in mind is that for each treatment it should be possible at all times to obtain the data (1–8) needed for the evaluation of the dose delivered to the irradiated tissues. Similarly in a paper enough data should be given to make it possible for the reader to estimate closely the doses which were effective in producing the results recorded. The fixed dosage factors may be specified concisely at the time the technique is described, thus avoiding tiresome repetition throughout the paper.

This report deals with the factors required to specify a dose of radiation in radium therapy. The biological effects produced in the tissues, and the final clinical results, of course, depend not only on the dose but on the nature of the tissues and many other biological and clinical factors. It is obviously just as important to specify accurately all these factors also. This part of the problem is within the domain of the medical radiologist, and for this reason we would offer the suggestion that one or two such men be included in the Standardization Committee for the coming year.

G. FAILLA, D.SC., Chairman
W. STENSTRRÖM, PH.D.
J. L. WEATHERWAX, A.M.

ADVANCED COURSE IN CANCER

Strasbourg, March 30, 1926.

My Dear Colleague:

I have the honor to send you enclosed the program of an advanced course in cancer organized by the Anticancer Center

of Strasbourg under the high patronage of M. Paul Strauss, Senator, Former Minister of Hygiene. This course will be held from Oct. 18 to Nov. 6, 1926. The closing session presided over by M. Paul Strauss will include lectures with discussion on questions of present-day interest on the subject of cancer.

I will be grateful if you will be so good as to publish in your Journal the program of the course of which I am sending you a copy.

DR. GUNSETT.

MEDICAL FAULTY OF STRASBOURG

Paul Strauss District Center of the Anticancer Campaign

ADVANCED COURSE IN CANCER

Under the High Patronage of M. Paul Strauss, Senator, Former Minister of Hygiene

Organized by Dr. Gunsett, Lecturer of the Faculty of Medicine, Director of the Anticancer Center of Strasbourg

With the collaboration of:

MM. Borrel, Professor of the Medical Faculty of Strasbourg; Canuyt, Professor of the Medical Faculty of Strasbourg; De Coulon, Chief of the Laboratory of the Anticancer Center at Lausanne; Mme. S. Laborde, Chief of the Radiotherapy and Curietherapy Service of the Anticancer Center for the Environs of Paris (Director Prof. Roussy) at Villejuif; Leriche, Professor of the Faculty of Medicine of Strasbourg; Mallet, Chief of the Radiotherapy Service of the Anticancer Center of the Tenon Hospital (Dir. Prof. Proust) at Paris; Masson, Professor of the Medical Faculty of Strasbourg; De Nabias, Chief of Service at the Anticancer Center of the Tenon Hospital at Paris; Neumann and Coryn, Associate Professors of the Medical Faculty of Brussels; Pautrier, Professor of the Medical Faculty of Strasbourg; Roussy, Professor of the Medical Faculty of Paris; Schickelé, Professor of the Medical Faculty of Strasbourg; Stolz, Professor of the Medical Faculty of Strasbourg; Weil, Lecturer of the Faculty of Medicine of Strasbourg; Vles, Professor of the Faculty of Medicine of Strasbourg.

This course will be given from Oct. 18 to Nov. 6, 1926, and will include:

1. Practical exercises at the anticancer center every day from 9 A.M. to noon, and from 3 to 5 P.M. under the direction of Dr. Gunsett.
   (*a*) Deep roentgen therapy with management of apparatus.
   (*b*) Curietherapie (radium tubes, radium puncture, etc.).

   The students will also have free access to the services of radiodiagnosis and physiotherapy (diathermia, ultraviolet rays, infra-red rays, etc.) which will be located in an adjacent building.
2. Theoretical courses at the anticancer center from Oct. 18th. The biological foundations of radiotherapy of cancer. The physical foundations of roentgen therapy of cancer. The physical foundations of curietherapy of cancer. The accidents due to roentgen rays and radium. Indications and technique of application of roentgen therapy and curietherapy of different cancers.
3. Theoretical courses in the clinics and institutes of the Faculty of Medicine.

SATURDAY OCT. 23, 1926

M. Borrel: The cancer problem.

MONDAY, OCT. 25 TO THURSDAY, OCT. 28

M. Canuyt: (*a*) Tumors of the nasal fossae and sinuses.
(*b*) Tumors of the pharynx.
(*c*) Tumors of the larynx.
(*d*) Tumors of the esophagus.

FRIDAY, OCT. 29

Leriche: Treatment of osteosarcomata.

SATURDAY, OCT. 30

Masson: Histodiagnosis of cancer. Biopsy.

MONDAY, NOV. 1

M. Pautrier: Tumors of the skin.

TUESDAY, NOV. 2

M. Schickelé: Cancer of the uterus and other genital organs.

WEDNESDAY, NOV. 3

M. Stolz: Tumors of the stomach, intestines and rectum.

THURSDAY, NOV. 4

M. Weil: Tumors of the eye.

FRIDAY, NOV. 5

M. Mallet: The applications of ionomicrometry to the practice of curietherapy of cancer.
M. de Nabias: The karyokinetic index and its application to the technique of curietherapy of cancer.

SATURDAY, NOV. 6

Closing Public Session (at Medical Clinic A of the Faculty) under the Presidency of M. Paul Strauss, Senator, Former Minister of Hygiene.

9 o'clock: Lectures with discussions:
MM. Neumann and Coryn (Brussels): The treatment of cancer of the rectum.
M. Proust (Paris): The treatment of cancer of the rectum.
M. Roussy (Paris): The mechanism of the action of irradiation on cancer.
Mme. S. Laborde (Paris): Technique and results of treatment of cancer of the neck of the uterus.
M. Gunsett (Strasbourg): Curietherapy of skin cancer (projections).
3:30. The physico-chemical characteristics of the normal organism and the cancerous organism. MM. Vles and de Coulon.

8 o'clock. Closing banquet.

Register with Dr. Gunsett, Director of the Anticancer center, Civil Hospital at Strasbourg. A matriculation fee of 250 francs will be paid to the Secretary of the Faculty of Medicine. A certificate will be given to the participants at the end of the course. The number admitted will be limited.

Dean of the Faculty of Medicine, President of the Administrative Committee of the Anticancer Center: WEISS.

Director of the Anti-Cancer Center: GUNSETT.

AWARD FOR RESEARCH ON THE ALIMENTARY TRACT

To encourage investigations of alimentary tract function, Dr. Frank Smithies, Chicago, has presented to the School of Medicine of The University of Illinois,

bonds in amount sufficient to yield annually, in perpetuity, not less than $100.00. This fund is known as "The William Beaumont Memorial Fund" and the income therefrom, as "The Annual Beaumont Memorial Award."

The Award is to be made each year to the research or clinical investigator, who, in the judgment of a Faculty Committee, has contributed the most important work during the year, in the field designated.

The first Award will be made in 1927. Manuscripts covering investigations do not have to be entered specifically for the Award nor is it required that they be submitted to the Faculty Committee. The Award is to be granted by the Committee after it has considered carefully all investigations published during any year in periodicals throughout the United States. Thus, the Award is available to workers in any institution, and is not confined to members of either Faculty or Student body of The University of Illinois.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A SIMPLE DEVICE FOR MEASURING TARGET-FILM DISTANCE

BY PAUL A. BISHOP, M.D.

Assistant Roentgenologist, Pennsylvania Hospital

PHILADELPHIA, PENNSYLVANIA

WITH convenient and accurate devices at hand for measuring voltage, milliamperage and time, there remains one variable factor, distance, which is not so well provided for and, consequently, is frequently neglected. The fixed markings on the tube stand are of limited use because the film is often placed on a different level, i.e., the bed, the stretcher, blocks, etc. The yard stick is not always at hand, and in the rush of routine a guess is resorted to at a sacrifice of good roentgenograms that can be duplicated.

We are now using a simple, home-made device which, being convenient, is used routinely and the distance factor is brought under control as easily and accurately as are the other variables, and at no loss of time.

An ordinary steel pocket tape, graduated in inches on its outer surface, is used. To one side of its case a bracket made of a strip of $\frac{1}{16}$″ brass or iron is soldered, and this is fastened with a screw to the base supporting the tube and its protective covering in such a position that the figures may be easily read by the operator as the tape emerges from the case. The size and shape of this bracket will vary with the type of tube-stand being used so that no specifications can be given. However, a strip of heavy lead foil fastened to the tape with adhesive plaster makes a splendid model which can be bent or cut easily until the proper shape is obtained.

The vertical distance between the target and the opening in the tape cover is measured (usually 6 or 7 inches) and a mark is placed at this distance from the end of the tape. The end of the tape is rolled

FIG. 1.

up about the ring at its end, to this point, and permanently fastened. When the ring thus formed is held in contact with the film-holder, the figure on the tape at its case opening will give the accurate measurement of the target film distance.

The release button of the tape is fastened down permanently so that as the tape is held on the film it automatically adjusts itself to the distance as the tube is raised or lowered, and springs back into its case when released.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

BOOK REVIEWS

RADIOGRAPHY: A Manual of X-ray Technique, Interpretation and Therapy. By Charles D. Enfield, M.D., F.A.C.P., Roentgenologist to St. Antony's Hospital and Norton Memorial Infirmary, Louisville, Ky. Cloth. Price, $10. Pp. 299, with 194 illustrations. Philadelphia: P. Blakiston's Son & Co., 1925.

A considerable number of medical men, not roentgenologists, are finding it worth while or necessary to do some or all of their own roentgenographic work; but the commoner details of technique and interpretation do not appear to be very readily available. These details, like much common knowledge, are accumulated by experience, but fail to be set down in convenient form. It also seems more difficult to get at a working interpretation of the everyday sort of things than of the exceptional.

This manual by Dr. Enfield was written with the above ideas in mind. It attempts to consider apparatus in a general way only, and without bias. It attempts to give, in such detail as to be intelligible to the novice, one good technique for each of the ordinary routine examinations: namely, those of the chest, gall-bladder, upper gastrointestinal tract, colon, nasal sinuses, sella and mastoids, teeth and jaws, urinary tract, heart and aorta, pneumoperitoneum and ventriculography, and of pregnancy.

It deals briefly with the interpretation of the commoner lesions, emphasizing the rule rather than the exception, and the roentgenograms pictured are those which the physician is most likely to encounter ordinarily. A detail of prime importance is the proper reporting of the roentgenographic examination, and this aspect is discussed clearly and adequately.

With regard to technique, the endeavor has been to describe the most advanced procedure which has become accepted as a standard. In addition, there have been included certain newer developments, such as an extremely rapid technique in the roentgenography of moving parts like the chest, heart, gall-bladder and intestines. There are, of course, chapters devoted to equipment, tubes and accessories, dark room and photographic materials, preparation for examination, and protection. A brief chapter at the close attempts no more than a brief outline of the principles of roentgen treatment in some common disorders where roentgen rays are important.

This manual is one that can be recommended by the roentgenologist to his medical colleague desiring elementary information respecting roentgenographic technique and interpretation. The material is clearly and logically presented, the illustrations are good, and except for the author's insistence on using the word principals for principles, the editing is quite good.

B. COHEN.

BOOKS RECEIVED

THE PEAKS OF MEDICAL HISTORY: An Outline of the Evolution of Medicine. By Charles L. Dana, A.M., M.D., LL.D., Professor of Nervous Diseases, Cornell University Medical College. Cloth. Price, $3.00. Pp. 105, with 40 full-page plates and 16 text illustrations. New York: Paul B. Hoeber, Inc., 1926.

THE TECHNIC OF ORAL RADIOGRAPHY. By Clarence O. Simpson, M.D., D.D.S., F.A.C.D., St. Louis, Mo. Cloth. Price, $5.00. Pp. 207, with 165 illustrations. St. Louis: C. V. Mosby Co., 1926.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

A COLLECTION OF ABSTRACTS ON EPIPHYSITIS

(Continued from the June Number)

FAIRBANK, H. A. T. Some affections of the epiphyses. *Proc. Roy. Soc. Med. (Sec. Orthop.)*, 1924, xviii, 1–12.

It is important to take roentgenograms in injuries in school children, however trivial the lesion may be, because it is possible that the bone may have been affected. A report is given of three traumatic cases, all in school boys aged sixteen, in whom the lesion would easily have been missed without perfect roentgenograms. The first case presented an early slight separation of the femoral head, i.e., an adolescent coxa vara. The roentgenogram showed widening of the epiphyseal line, and definite, though slight depression of the right femoral head on the neck. Weight extension was applied in an effort to correct the slight displacement of the head of the femur but this could not be achieved. The plaster cast was removed after three months and the boy was cured without any further increase in the deformity.

In the second boy the roentgenogram showed partial separation of the great trochanter, the space at the site of the epiphyseal line of the great trochanter being definitely wider on the affected side than on the normal. Abstinence from active exercise for several months effected cure. In cases like this the displacement is usually not great and the diagnosis is difficult. Some of the cases reported in the literature seem to have been primary cases of infective osteomyelitis with secondary separation of the epiphysis.

The third case occurred in a boy aged nearly seventeen, who showed a rather rare injury. The roentgenogram showed separation of the epiphysis of the anterior inferior iliac spine, the center for which appears at the fifteenth year, or later. In the stereoscopic film a clear area was seen on the left at the site of the iliac spine, while on the right the clear area was almost filled by the normally situated opaque epiphysis. The above three cases were definitely caused by trauma received on the football field.

While there is some doubt as to whether Schlatter's disease is necessarily traumatic in origin, although it is certainly aggravated and kept up by the pull of the ligmentum patellae, there is no doubt that all types of cases are met with, from the complete traumatic avulsion of the tubercle, to the type in which no displacement is present and trauma seems to play no part in the onset. The following case is regarded as exceptional in that the plane of the fracture passed up through the epiphysis into the joint, the anterior part of the articular surface of the tibia being displaced. This occurred in a boy aged fourteen, attempting to jump a rope when something "gave" in the knee as he took off with the left foot. The roentgenogram showed the displaced fragment to consist of the anterior third of the articular surface of the tibia as well as the tubercle. At operation the fragment was forced back into place and fixed with a beef bone screw. The result was entirely satisfactory.

Three other cases of "Schlatter's knee" are mentioned for the sake of comparison, the first in a boy aged fourteen, with symptoms for four months, showed in the roentgenogram the typical fluffy condition of the tongue-like process forming the tubercle and of the bone beneath it, with some irregularity of the intervening cartilage. The other two cases occurred in boys aged thirteen and a half years. Abstention from all games for a period has been sufficient in most of the cases to relieve symptoms, though the possibility of a recurrence cannot be said to have disappeared until fusion of the tubercle with the shaft of the bone has occurred.

A less known, though not less common affection of a similar nature is osteochondritis of the heel epiphysis. It is an affection of the epiphysis to which a strong tendon is attached so that trauma would naturally be expected to play a part in causation. While in "Schlatter's knee" trauma plays a more prominent part than in the others, the impression is strong that a mild infection must be present in all and more particularly in cases of the heel and of the navicular tubercle. The great majority, if not all of the cases of supposed tearing off of the navicular tubercle are really explained by the presence of a separate center of ossification in this tubercle. Osteochondritis of the heel affects boys more commonly than girls, and is usually unilateral. The ages of the patients vary from eight and a half to fifteen years. The pain is definitely in the heel and not beneath it, and is aggravated by violent exercise. Flat foot may be present and occasionally there is some shortening of the calf muscles. Roentgenograms show a fluffy, eaten out or fragmented epiphysis with

unusual irregularity of the adjacent posterior surface of the body of the os calcis. Great irregularity of this surface has been met with in large number of roentgenograms especially examined only when symptoms of the disease had been present at some time or other. The epiphysis may ossify by more than one center and, as in the case of Schlatter's disease, roentgenograms must be examined in conjunction with the clinical evidence unless the changes are very marked or unilateral. The three cases briefly cited occurred in a girl aged eight and a half, a boy twelve and girl thirteen years old.

A condition of similar nature is the affection of the tubercle of the tarsal scaphoid to which is attached the tibialis posticus tendon. Both the scaphoid and the os calcis may be affected in the same foot. This condition is entirely different from Köhler's disease or isolated disease of the naviculare. The affection is of the navicular tubercle only and not of the whole bone. Almost invariably a separate center of ossification is present in these cases for this tubercle, the so-called os tibiale externum. The presence of the epiphysis at this point makes the anatomical condition similar to those in the heel and the tibial tubercle. In only one or two cases has there been any suggestion of fluffiness of this epiphysis. Girls are nearly twice as commonly affected as boys, the ages varying from nine and a half to sixteen years. Treatment should aim at supporting the arches and varying degree of rest should be ordered according to the severity of the symptoms. Three such cases are briefly mentioned.

Another very rare condition, apparently unknown to many anatomists, is a separate center of ossification for the internal malleolus. This may be unilateral or bilateral and the condition was revealed only by routine roentgen examinations.

The last condition reported is that of a dislocation of the elbow with separation of the epiphysis of the internal epicondyle. This appears to be a very rare condition, although 4 such cases were met with by the author in the last two years. It seems advisable to keep these cases in mind, particularly when recovery is delayed after reduction of the dislocation of the elbow.

FELS, ERICH. Development of the tibial tuberosity and the genesis of Schlatter's disease. *Arch. f. klin. Chir.*, 1924, cxxix, 552–562.

Most of the information on the ossification of the tibial tuberosity has been obtained from roentgenological studies, and systematic microscopic and macroscopic studies of its ossification have not been made. The author, therefore, set about to supply this information. A study was made of the head of the tibia at various ages up to twenty-three years, when normally ossification is complete. This study was based on 79 tibias comprising 4 from the fetus, 13 newborn infants, 17 in the first decennium, 36 from ten to eighteen years and 9 up to twenty-three years. Males and females were represented, the former predominating somewhat.

The results of this study show that calcification of the tubercle varies within a few years. Its earliest appearance is at about twelve years, and the whole process terminates somewhat earlier in the female than in the male. Once the bone nuclei make their appearance, the replacement of the cartilage by bone occurs rather rapidly, and the cartilaginous layer between diaphysis and the projection, becomes continually smaller with time, disappearing finally at about eighteen years. This of course is the picture in the "normal" osseous system. Such matters as physical constitution, condition of health and functional activity may affect the picture quite appreciably.

A review of the roentgen pictures of Schlatter's disease and a comparison with the normal preparations leaves an impression with the author that many conditions labeled "Schlatter's disease" do not belong in this category. Even in cases that cannot be described as Schlatter's disease one can often observe a further displacement of the tibial tubercle from the diaphysis. If there should happen to be a sharp notch at the insertion of the tendon so that the whole tubercle appears to be notched, the roentgenogram may easily give the impression of separation of the tubercle. If added to this finding, there is present slight pain as is quite possible with such a prominent projection, the confusion with Schlatter's disease is almost perfect. This name should be reserved only for those cases in which there is an undoubted separation of the tubercle from its contact with the diaphysis or where a partial separation is definitely demonstrated.

Of the various causes suggested for Schlatter's disease, the anatomical considerations seem to indicate that late rickets may be responsible in many cases. An unusual tug on the quadriceps tendon which in an individual with a healthy osseous system would be tolerated, and even in an individual with an unhealthy osseous system would not cause trauma may very well cause a separation of the tubercle in a case of late rickets. Additional support in favor of this theory is the fact that separations of the tibial tuberosity have occurred more frequently in recent years. This may be because physicians are now more familiar with Schlatter's disease; yet, another reason may be that

the present greater incidence of late rickets may be responsible for a greater incidence of Schlatter's disease.

HEACOCK, CHARLES H. Osgood-Schlatter's disease, with report of case. *Colorado M. J., Denver*, 1924, xxi, 365–368.

A case is reported occurring in a athletic boy, aged fifteen, who complained of pain below both knees. The trouble had begun about a year previously and became progressively worse; even walking resulted in pain, which persisted for about an hour after he became quiet. There was a swelling below each knee which appeared at the time pain was noticed. Below each knee there was symmetrical swelling over the tubercle of the tibia. These eminences were firm and deep pressure caused pain. Motion, especially extension, was moderately limited.

Roentgenograms of both knees showed the epiphyses of the tibial tubercles to be separated from the shafts. There was an avulsion of the left tubercle and there were multiple loose fragments of bone torn from the tubercles on both sides. The roentgen-ray diagnosis was Osgood-Schlatter's disease.

The treatment consisted of rest and strapping with adhesive. Improvement began in about three months. The swellings have remained unchanged and the boy experiences pain if he exercises too vigorously. Roentgenograms taken one year later show marked progress in the union of the epiphysis and diaphysis. The normal anterior contour of the tibia is almost wholly restored. The loose fragments persist and are even slightly enlarged.

GREENLEAF, WM. S. Schlatter's disease. *J. Radiology*, 1924, v, 426.

A brief report is given of a case occurring in a boy aged fourteen who had received a slight injury of the left leg below the knee a year previously. The physical examination revealed a slight swelling of the left leg just below the patella. There was slight tenderness on pressure, but not marked. The roentgen examination showed a separation of the anterior portion of the upper epiphysis of the tibia at the site of the insertion of the prepatellar tendon, together with a slight new bone formation at the same site. This picture was considered typical of Schlatter's disease.

EMMERT, MAX. Schlatter's disease: A case report. *J. Radiology*, July, 1925, vi, 278–279.

A brief description is given of a case occurring in a man aged twenty-five, complaining of "sore knee." At the age of ten he had noticed an enlargement and tenderness at the site of attachment of the right patellar ligament. He had no knowledge of an injury.

In 1917 the roentgenogram disclosed the presence of a small bony nodule apparently detached from the tibia. In 1920 he was thrown from a horse and injured the right knee. Since that time he thinks there has been an increase in size of the mass and increased soreness upon flexion of the leg. Examination revealed the presence of a small firm mass above the right tibial tubercle. Flexion of the leg revealed a definite firm mass and increased tenderness. There was a tongue shaped bony protrusion lightly attached to the underlying spinous process which did not appear to be completely ossified. An incision was made through the patellar ligament, the bony mass was easily separated from the surrounding tissue, and the wound closed. The patient was seen two weeks after operation, at which time he was bending the knee with perfect comfort.

OLLERENSHAW, ROBERT. Observations on the Osgood-Schlatter disease. *Brit. M. J., Lond.*, Nov. 21, 1925, ii, 944–945.

The author regards what is known as Osgood's or Schlatter's disease as the representative in childhood of the fracture of the patella in the adult. He feels sure that the two lesions of childhood, (1) separation of the tibial tubercle, and (2) fracture of the lower edge of the patella are due to the same cause because he has seen 3 patients in whom both knees were simultaneously and similarly injured; and on examination one knee showed a separation of the tibial tubercle while the other showed a torn off lower edge of the patella.

This lesion is regarded as a fracture and should be treated as a fracture by complete immobilization for six weeks. Most of these fractures consolidate if completely immobilized, but a few old standing cases having a tender non-union are improved by operative fixation of the fragment to the diaphysis.

More than half of the author's cases occurred in girls, although it is generally stated that the condition is more frequent in boys. It is suggested that perhaps the girls of the North of England, from which these cases were mustered, must be more tomboyish than those in Boston where Dr. Osgood's cases were found.

POMERANZ, MAURICE M. Lesions of the tibial tubercle (Osgood-Schlatter's disease). *Am. J. Surg., Elmira, N. Y.*, February, 1925, xxxix, 17–23.

A report is given of a series of 17 cases demonstrating lesions of the tibial tubercle of the Osgood-Schlatter type. Avulsion of the pretibial tubercle occurs most frequently in the

adolescent. The disease is more common than generally supposed, and absence of acute symptoms explains the scarcity of case reports. The architecture of the joint is such as to safely withstand moderate trauma.

Most of the cases comprising this report occurred in males and in the left knee, which is at variance with other published reports. The lesions are most commonly traumatic, although 2 cases of the infectious type were noted. Dense reactive sclerosis occurs in old lesions. The types of cases vary according to the severity of the trauma, from simple stress or avulsion of the periosteum to complete avulsion with fragmentation of the process.

Mild cases may be negative roentgenologically or may at least present a negligible or hardly discernible separation of the apophysis. In direct trauma or severe muscular stress more extensive separation results. The amount of separation will depend on the degree of development of the part. In tubercles formed from the epiphysis of the head, the separation is, as a rule, en masse, and a definite space may be demonstrated between the tubercle and its osseous attachment. In those formed from multiple centers of ossification the appearance presented is somewhat as follows: The distal fragment is the point of attachment of the patellar tendon and as such sustains the brunt of injury. This segment is often pulled free and projects as a definite bony prominence on the anterior aspect of the knee. In the severe muscular stress, the lower pole of the tubercle may be pulled loose and displaced upward and forward in front of its upper half and united in this position. Often in direct injury the picture of a comminuted fracture of the part may be produced. Among the soft tissue alterations that are observed roentgenologically, bursitis and synovitis are commonly present. Periarticular swelling is the result of both intra- and extra-articular injury, and is noted chiefly on the anterior aspect of the tibia, and on the sides of the patellar tendon.

Van Neck, M. New considerations of Schlatter's disease. *Arch. franco-belges de chir.*, 1923, xxvi, 1060–1066.

This disease is found in adolescents and in children of the pre-puberty age, and is manifest by painful swelling and pain in movement in the apophysis of the anterior tibia. Roentgenograms show ossification abnormalities. Normally the apophysis develops from a center which appears toward puberty; the superior tibial epiphysis, at the same time, grows in extension before meeting the center and united to this for many months, continuing as a sort of lip or projection separating from the diaphysis by a slender clear space which disappears toward the age of eighteen years. Center and prolongation are of the same density. In Schlatter's disease the conditions are extremely variable: simple decalcification; retardation of fusion of centers; large clear space separating epiphyseal projection of the diaphysis; irregular projection (lip), divided, decalcified in places; osteophytes; absence of fusion between diaphysis and epiphysis persisting up to mature age. The disease evolves to spontaneous cure. Schlatter attributes the lesions, especially solution of persistent continuity between center and the epiphyseal lengthening, to a direct or indirect traumatism. Numerous observations have been made without discovering any casual traumatism. Thompson has produced apophysial periostitis provoked by action of quadriceps. Kienböck gave the diagnosis of osteochronditis. Certain authors consider the cause to be nonmicrobic inflammation. Kienböck in one case found the tubercle bacillus present. Ebbinghaus found an inflammatory reaction in the apophysis at the level of the small separated fragments; the cartilage was intact; in the thickening of the quadriceps tendon abundant leucocytic infiltration. Graef, Schultze have observed thickening (periostitic) of the insertions of tendons of the members in certain subjects showing apophysis; they consider the affection as not a symptom of a general affection. The affection, according to published cases, is always local. There are some arguments for slow rickets.

Six case reports are then given:

Case 1. Boy aged 13 years, thin but well proportioned, with normal constitution. Antecedents are chicken-pox, diphtheria, scarlet fever, appendicitis operation. The only point of interest is that his mother and his uncle suffered the same affection. When very young the boy complained of pain in the right knee, but the roentgenogram showed nothing abnormal. After a short time he had pains in the left knee in the region of the apophysis, such pain increasing when he walked. The two apophyses were swollen, the left more than the right; they were sensitive to pressure, as well as the region adjacent to the knee cap. The roentgenogram showed conditions resembling bilateral Schlatter's disease, characterized by enlargement of the cartilaginous space and irregular ossification. Nine months later, roentgenogram showed apophyses on the left knee diffuse and decalcification almost normal. The apophysis remained swollen.

Case 2. Sister of Case 1, aged nine years, in perfect health, showed slight swelling of the two apophyses. Did not complain of any pain. The roentgenogram showed only slight decal-

cification and slight tissue separating the center and the lengthened epiphysis on one side.

Case 3. Age fourteen; large, robust and without antecedents. Complained for nine months of pain in left tibial apophysis. This tuberosity was notably larger than on the right. Here the roentgenogram revealed a kind of definite exostosis ascending in the thickened tendon of the knee cap; the interlined cartilage is hardly visible. On the left side the apophysis is decalcified, irregular, separated from the diaphysis by a large clear space. Pressure on the apophysis is painful only on the left; the tendon is not painful.

Case 4. Aged thirty-eight. Tibial apophysis in the left knee is pronounced; no pain on pressure; only the knee-cap and adjacent tendons are sensitive to touch. Toward the age of ten years, the subject noticed swelling of his left apophysis, but no pain. Roentgenogram showed a kind of osseous nucleus joined to the inferior articular epiphysis, presenting a small hypertrophy in the form of a thorn or sharp point.

Case 5. Age seventeen and a half years. No antecedents. Condition supposed to have been result of rickets; the roentgenogram showed no trace of this disease. Complained of vague pains in the upper tibia; the two apophyses were slightly swollen and sensitive to percussion; the adjacent tendon was also sensitive. The roentgenogram showed in the inferior part of the apophysis a zone of decalcification stretched equally on the diaphysis. The left knee six months later showed advanced recalcification (roentgenogram).

Case 6. Aged nine years, well proportioned, slightly fat, tall as child of eleven; no antecedents; no rickets. Complained of slight pains in right knee; tuberosity was slightly swollen; were painful to touch, as well the tendon. The roentgenogram showed in the right knee: apophysis of diffuse contour, irregular density, enlarged cartilage; the left knee the apophysis properly defined, decalcified, separated by lengthened epiphysis. Three months later the roentgenograms showed the same features. Six months afterward the right knee showed the apophysis to be reconstituted, but the knee-cap presents the same lesions as the left three months previously.

No hereditary syphilis in any subjects; no traumatism, direct or indirect. Symptoms of all were pain in the apophyses and in the neighboring portion of the knee-cap tendon.

The author considers this condition to be a tenositis or a tenocellulitis of the knee-cap tendon. This remains generally localized in the inferior part of the tendon giving rise to inflammation of the neighboring apophysis.

KÖNIG, E., and RAUCH, H. On the histology and etiology of Köhler's disease of the metatarsus. *Arch. f. klin. Chir.*, 1924, cxxviii, 369–381.

The authors find that the primary process in Köhler's disease of the metatarsus is a disease of the periosteal vessels. As a consequence of this disease there is a retardation in circulation and nourishment leading to regressive and destructive changes in the epiphysis. The cause of the disease of the vessels is probably to be found in the organs of internal secretion which regulate ossification.

A report is given of a case occurring in a girl aged fifteen who showed the typical clinical and roentgenological characters of Köhler's disease of the second metatarsus in the left foot. Trauma was positively denied. The roentgenogram showed marked destruction of the head of the second metatarsus. The shape of the bone was preserved, but it was somewhat shortened. The fine structure of the trabeculae was absent, and in their place directly below the joint surface there was seen a narrow, diagonal strip of condensation, and along the sides there were small circular areas of rarefaction. No changes in the diaphysis could be found. The joint space and the adjacent surface of the basal phalanx were normal in appearance. There were no signs that could be interpreted as evidences of arthritis deformans. All these points indicate that this case was an early stage of Köhler's disease.

Conservative treatment for several months failed to give relief and operation had to be performed. The patient recovered within ten days and has remained free of all symptoms since. The resected head of the metatarsus was subjected to careful histological study. This examination showed a partial replacement of the spongiosa and of the marrow in the epiphysis by a highly vascular, fibrous connective tissue. Reaching from the latter was a broad fibrous band extending to the very much thickened metatarsal periosteum. The latter contained numerous narrowed vessels with very thick walls. In the epiphyseal connective tissue there was osseous regeneration partly by direct apposition and partly after a cartilaginous fore-stage. Directly below the joint cartilage there were found occasional dead bone fragments and two other minute foci of necrosis. The ingrowing periosteal band of connective tissue suggests very strongly the picture seen in chondrodystrophia.

The above histological findings do not agree completely with any of the descriptions so far recorded. It differs very considerably from

the findings of Axhausen and of Cahen-Brach in that there was practically complete absence of necroses. There was absence of giant cells, which does not agree with the findings of Klett and Cahen-Brach. There was no zone of bone destruction. In agreement with other studies, the present case showed the zone of fibrous replacement in the marrow, surrounding a wall of active vascularization and separating the latter from the normal spongiosa.

LEWIN, PHILIP. Juvenile deforming metatarsophalangeal osteochondritis. *J. Am. M. Ass.*, 1923, 189–192.

This condition is erroneously known as Köhler's metatarsophalangeal syndrome. Freiberg called it infraction of the metatarsal head. Skillern prefers the term impacted fracture to that of infraction. He calls it an "egg-shell" fracture. On the assumption that it is analogous to similar conditions in other regions, especially in the hip, the author adds the term metatarsal epiphysitis, metatarsal "flat-head," or osteochondritis deformans metatarsojuvenilis. A more descriptive term is one given in the title. The etiology of the condition is unknown and is in the same stage that Legg-Calvé-Perthes' disease was a decade ago. The author believes that it has an etiology similar to that of the previously named hip condition, of Osgood-Schlatter's disease, Köhler's disease of the tarsal scaphoid, calcaneal apophysitis and Scheuermann's vertebral epiphysitis. When trauma affects bone and cartilage during the period of unusual growth, the foregoing conditions may result. The important immediate factors are trauma, affected circulation and infection.

Reports are given of two cases occurring in girls, one aged fourteen and the other twelve. The symptoms of the condition are as follows: There is a uniform complaint of pain referred to the region of the affected metatarsal head. Swelling due to exudate is usually present. No marked increase of joint tension is demonstrable. There is very marked, sharply circumscribed sensitiveness to pressure over the metatarsal head and the metatarsophalangeal joint. Abnormal local temperature is unusual. Definite limitation of motion with muscle spasm is present. Abscess formation has not occurred in the cases reported. (Sixty-five cases, including the two here reported, have been observed to the date of this paper.)

Credit for the recognition of this condition is due to the roentgen findings, which are characteristic. They are, (1) flattening of the metatarsal head; (2) broadening of the neck and distal portion of the shaft; (3) irregularity of the epiphyseal line; (4) widening of the metatarsophalangeal joint space; (5) diminished cupping of articular surface of proximal phalanx, and (6) occasional line of incomplete fracture without displacement. Other authors have found areas of sequestration similar to those observed in the two cases here described.

The disease occurs more commonly in growing girls than in boys, and in view of the fact that metatarsalgia is relatively uncommon in childhood, it is advisable to have roentgenograms made of both feet of every child who has a persistent metatarsalgia. It is possible that the first film will be negative; and the examination should be repeated. If recognized early and with proper treatment the prognosis is excellent. The course is short and lasts but a few weeks. The treatment consists of relief from weight bearing. The differential diagnosis rests between Morton's metatarsalgia, Deutschlander's metatarsal periostitis, fracture, dislocation, syphilis and arthritis of childhood, e.g., Poncet's or Still's disease.

MEYER, M. Köhler's disease of the second metatarsus. *Beitr. z. klin. Chir.*, 1923–24, cxxx, 655–683.

Köhler's disease of the second metatarsus is a disease occurring during the age of growth and seems to be more prevalent in the female. The primary site of the affection is the epiphysis; shaft and articular changes are of secondary nature. The differences in the various roentgen pictures may be explained as due to the different stages of the disease in which they were taken.

The etiology is not completely understood. A mild embolic origin is possible and may perhaps be true for many cases. Usually the disease appears to be caused by repeated traumas of a slight nature, such traumas producing injuries of the bone cartilage boundary, the process produced eventually resulting in necroses, with ultimate collapse of the cap. This theory finds support in the anatomical structure of the bones of the foot. A general disease weakening the bony system is a possible contributory cause, but is not a necessary essential in the causation of Köhler's disease.

Köhler's disease has a very great similarity to osteochondritis coxae juvenilis of Perthes and osteochondritis dissecans of König. Late rickets and osteitis fibrosa are diseases of entirely different category.

The treatment of Köhler's disease should be tentative and conservative. Operation is indicated when conservative methods fail, when the cases are well advanced or for social reasons.

Fifty cases reported in the literature from 1920 to 1923 are briefly summarized. In addition the author reports two cases in which he

had the opportunity to make histological examinations.

BRAGARD, KARL. On the prognosis and therapy of osteomalacia of the head of the metatarsal (Köhler's disease). *Münchcn. med. Wchnschr.*, Jan. 23, 1925, lxxii, 127–128.

Among the various osteomalacias Perthes' disease and Köhler's disease have very striking similarities. The various phases of these diseases are practically identical. This fact is of great significance in the prognosis and therapy, especially of metatarsal disease. Three stages are distinguishable roentgenographically. The early stage shows focal necrosis with shape of the head intact. The middle stage is that of compression: coxa plana. The final stage is one of arthritis deformans of favorable or unfavorable type. The details of these stages are described and illustrated by drawings.

A case is described in a patient fifteen years old, showing severe rachitis, scoliosis and affection of the second left metatarsal head. The condition when about fourteen days old showed from above two small transparencies, and from the side a wedge-shaped focus in the plantar half of the head. When four months advanced, the condition from above showed the cap of the head dissolved away laterally with a wedge-shaped entrance for the metaphyseal regenerative tissue; and viewed from the side, there was butterfly shaped extension of the malacia to the dorsal portion of the head. When advanced seven months, the condition showed from above the spongiosa in the affected area had a washed out appearance (regenerated bone tissue) and the wedge-shaped crack in the lateral edge of the joint closed up again. Viewed laterally the area showed the bone canaliculi plump and faint. Practically the whole head of the metatarsal was newly regenerated.

This indicates that the regeneration process in the metatarsal requires about four months for completion. The author's experience indicates that therapy in the first two stages must be only conservative.

KÖHLER, A. On the first announcements of the typical disease of the second metatarsophalangeal joint. *Münchcn. med. Wchnschr.*, 1924, lxxi, 109.

The first description of the disease picture given by the author (not exhaustively discussed) was in manuscript as a section to the second edition of the author's book (Grenzen des Normalen, etc.) and was published toward the end of 1914 or the beginning of 1915. The original communication of Freiberg in 1913 at a meeting of the Southern Surgical and Gynecology Association, Cincinnati, therefore, preceded the author's publication by a few months.

Since Freiberg definitely recognized this disease he should be given due credit for it.

It is the author's point, however, that the most characteristic feature of this disease was entirely missed by Freiberg, although it was present in the 3 cases he described. This feature is the high grade, almost uniform distally increased thickening (with disappearance of the neck) of the total distal half of the involved metatarsus. This important character was first published by the author in his lecture in 1920, and it is only after this last communication that attention has been attracted sufficiently so that new cases are being discovered from month to month.

The seven cardinal symptoms established by the author are, changes of the base of the proximal phalanges, considerable broadening of the joint space, striking irregularity of the latter, flattening of the cap, calcium bodies in the joint capsule, shortening of the head of the metatarsus, thickening of the distal half of the metatarsal with disappearance of the neck. Freiberg mentions only three of these, namely, impressions of the head, calcified joint bodies and shortening of the head.

AXHAUSEN, G. Köhler's disease of the metatarsophalangeal joint. *Med. Klinik*, 1923, xix, 561–565.

It is important for the general practitioner to be able to recognize this condition, because sufferers rarely apply to the specialist when in the early stages. Successful treatment depends upon an early recognition of the disease.

The roentgen findings in the later stages of the disease are definitely characteristic; and also in the early stages. The author has observed cases of the disease in all stages of development and distinguishes five stages according to the roentgen findings. In the first stage the roentgen picture shows no softening whatever in the bone. Recognition of this stage is possible only from the clinical features. In the second stage the joint surface is flattened and the distal segment is condensed in structure and appears flattened out as if by force, with the squeezed out upper surface extending over the edge of the bone like eaves. The metaphyseal shaft shows the commencement of bone thickening due to deposit of new bone.

In the third stage we find a pronounced flattening and broadening of the epiphysis. The flat joint contour runs laterally over the shaft often overhanging the edges. The bone structure of the epiphysis is changed pronouncedly: thickened portions of bone in the middle surrounded by light transparent zones so that a

"sequestrum-like" picture results. The metaphysis and the adjoining portion of the shaft are much thickened by large deposits of bone in which the original compact elements merge. In many cases, there are also present small circumscribed bone shadows lying to the sides of the other epiphyses. In the fourth stage, the sequestrum-like boundaries have disappeared. The head of the metatarsus is very much deformed. Its joint surface is sunken, and the edges spring up sharply, while the epiphysis is very much broadened. The thickening of the neck of the bone and of the shaft has become considerably diminished and the external shape and internal structure has in a large measure returned; the dense bony tissue is still somewhat broader than the normal and denser. Frequently slight irregularities are noticeable in the adjacent joint surface of the proximal phalanx.

In the fifth and last stage we find the picture of severe arthritis deformans. In addition to alteration of the head of the metatarsus there are extensive changes of the adjacent joint surface of the proximal phalanx; flattening of the joint contour, sclerosing of the subchondral bone and enormous marginal elevations. On the other hand, the shaft of the metatarsus has regained to a considerable degree its original shape.

According to the author the anamnesis, roentgen picture and histological finding all are unanimous and definite against a traumatic etiology of this condition. Practically all of the cases have denied trauma in relation to their illness. Roentgenologically such sequestrum-like structures are not recognized as sequelae of fracture; neither can the pronounced shaft thickenings be considered the results of epiphyseal infractions. Moreover, the histological findings show pictures entirely different from those one would expect following recovery from fractures in general, or of fracture healing in the subchondral epiphyseal region in particular. Experiments performed by the author show that the healing process following ordinary fracture and infraction is the usual one found in bone healing.

Detailed descriptions are given of the histological changes observed in each of the five stages. These findings correlate well with the roentgenological details above described. The characteristic of this disease is the peculiar process occurring in the head of the metatarsus and not as Köhler originally assumed, in the thickening of the shaft. The condition is not an infraction of the healthy head but a complete interruption in nutrition of the bony epiphysis followed by a pathological fracture due to impression of the plantar joint surface. The end result is a condition analogous to arthritis deformans. The name for this disease suggested by the author is arthritis deformans infantilis or juvenilis of the metatarsophalangeal joint.

A consideration of the disease process as pictured in the progress from the first to the last stages suggests that if necrosis can be prevented, the disease may be headed off and healing brought on. Therapy planned with this in mind has been found exceedingly effective in stopping the progress of the disease and in initiating recovery.

ENGELKE, OSKAR. Two more cases of Köhler's disease of the head of the second metatarsus. *Klin. Wchnschr.*, 1924, iii, 1129–1131.

The descriptions in the two cases correspond in important points with those given by Köhler, the only difference being that in one of the cases here presented there was no thickening of the shaft, while at the same time there was present a rarefaction at the base of the proximal phalanx, which microscopically was found to correspond to a fibrous change of the marrow with disappearance of the bone canaliculi.

It is the author's opinion that Köhler's disease follows as the result of a fibrous alteration in the bone marrow due to some unknown cause. It may be that several different factors are involved, such as age, sex, mechanical stress, and altered static conditions.

AXHAUSEN, G. The anatomical-pathological course of Köhler's disease of the head of the metatarsus and of Perthes' disease of the hip. *Arch. f. klin. Chir.*, 1923, cxxiv, 511–542.

A careful study of the anatomy and pathology in Köhler's disease makes it quite evident that trauma is most certainly not the primary etiological factor. Nevertheless an impression fracture can usually be demonstrated, but this is not a simple fracture of a normal bone but rather a pathological fracture of a very much altered, i.e., totally necrotic and eaten out bone. It is not the cause of the disease picture but one of the results of a totally different primary disease condition, namely, the interruption of the epiphyseal nutrition.

The author has had an opportunity to carefully examine 12 cases of Köhler's disease, in 6 of which histological studies were made of the resected bone. On the basis of these studies he has been able to distinguish 5 stages of the disease, not according to the clinical picture which remains essentially constant, but according to the roentgen changes. The first stage reveals only a normal roentgen picture. Such a case is described in a girl aged twelve, who suffered from the complaint for five weeks. The roentgenogram was apparently normal, yet

the resected bone when examined histologically under high magnification showed the whole bony epiphysis together with its marrow to be completely necrotic. This necrosis was sharply limited to the bony epiphysis. There was no evidence whatever of an impression fracture of the plantar joint surface. This is regarded as absolute proof that the disease is initiated not by a fracture but by interruption in nutrition of the epiphysis.

The second stage shows a flattening that has the appearance of being "squeezed in" and there is thickening of the "squeezed in" portion of the epiphysis. This is illustrated by a case in a girl, aged thirteen, who had been suffering for three months. The histological findings in this case were largely similar to those in the firs . There was necrosis of the whole bony epiphysis (bone and marrow) which was sharply limited to the epiphysis. There was a reactive proliferation of the metaphyseal periosteum with the first signs of a bone deposition upon the external metaphyseal surface. There was also a growing through of spurs of metaphyseal periosteum through the joint cartilage close to the boundary toward the epiphyseal cartilage, with extension in the adjacent marrow spaces of the dead epiphysis. The weakened plantar oint surface had given way under the strain and had been pushed in against the epiphysis (pathological impression fracture).

The third stage shows focal "sequestrum-like" bone islands within the strongly flattened and broadened epiphysis. The edge of the bone is serrated and there is thickening of the distal portion of the shaft. This stage is illustrated by a case occurring in a girl aged sixteen who had been suffering from the disease for nine months. The histological examination revealed a conglomerate of necrotic bone located at the plantar joint surface underneath the cartilage. Some of the marrow space was filled with necrotic marrow and some with dense, finely granular masses of bone meal. Another similar illustration was found in a fifteen year old girl who had the disease for one year.

The fourth stage shows profound transformation of the head of the metatarsus. This was illustrated in a girl aged twenty, who had had the disease for two and a half years. The roentgen picture showed deformity of the head of the second metatarsus. There was pronounced shortening and enormous broadening of the epiphysis; there was a deep key-shaped indentation of the joint surface, which was hung over on the edge by a thick marginal eminence. There was a medium thickening of the distal portion of the metaphyseal shaft and broadening and condensation of the compacta. There was slight irregularity of the basal joint surface of the proximal phalanx. The histological picture showed an aggravation of the previous condition with regenerative efforts evident here and there. In the vicinity of some of the necrotic bone areas there were evidences of new bone formation. It seemed clear that during the process of epiphyseal reorganization traumatic injuries had been inflicted.

The fifth stage is one showing severe arthritis deformans with involvement of the basal joint surface of the proximal phalanx. There was in addition a retrogression of the shaft thickening. This is illustrated in a patient aged thirty-two. The roentgen picture of the foot as well as that of the resected head of the metatarsus showed no break in continuity and no change in form; there was only a slight thickening of the bone structure in the most external portion of the epiphysis. The bone shaft remained unchanged. Corresponding findings were made in the microscopic section. The epiphysis was filled throughout with living, slightly thickened marrow. The trabeculae were living but showed in many places a reticular structure. The latter was also observed in the spongiosa of the subchondral region. There were also small residues of necrotic spongiosa. At the plantar edge the joint cartilage and metaphyseal bone edge came together without any separation. The metaphyseal periosteum was in a resting stage.

The five successive stages above described present a fairly clear and consecutive picture of what takes place in Köhler's disease of the second metatarsus. The primary effect is not a shaft thickening which Köhler originally assumed, but the intimate processes taking place in the head of the metatarsus. The latter are due to the complete interruption in the nourishment of the bony epiphysis which as a rule leads to indentation of the plantar joint surface in the form of pathological fracture.

In Perthes' disease we also find roentgenologically the various phases of development which have been described above for Köhler's disease. The interruption in nutrition of the bony epiphysis and the early stage of its reorganization are not revealed in the roentgenogram and consequently a good deal is missed in the early stages. The disease results in a flattening of the joint surface, a shortening of the vertical diameter of the cap, and a compression of the spongiosa structure. It is, however, necessary in order to establish the clear relationship of Perthes' disease to Köhler's disease to make pathological examinations such as those described above; but as a rule Perthes' disease runs such a mild course

that there is little necessity for resection and consequently little opportunity for the necessary pathological study.

Altschul, W. Köhler's disease of the second metatarsus. *Med. Klinik*, 1924, xx, 42–44.

A brief description is given of 5 cases observed by the author within a span of one year. It is pointed out as rather peculiar that reexamination of roentgenograms taken in the preceding fifteen years did not disclose a single case of this condition.

Considering the above 5 cases and 42 others found in the literature, the author attempts the explanation of Köhler's disease as follows: By change in the static conditions, the head of the second metatarsus becomes subjected to increased pressure. This brings on a pressure necrosis of the epiphysis which ultimately breaks down and there follows a reconstruction of the epiphysis through regenerative processes in the metaphyseal periosteum. The proliferation of the metaphyseal periosteum extends also in the direction of the diaphysis, thus producing a thickening in the diaphysis. Possibly such cases possess a constitutional weakness of the osseous system.

Cahen-Brach, F. The etiology of Köhler's metatarsal disease. *Arch. f. klin. Chir.*, 1923, cxxiv, 144–164.

Köhler's disease of the second metatarsus progresses without fever. It localizes only in the capitulum of the second or third metatarsal involving the epiphysis and metaphysis and it involves secondarily the whole metatarsophalangeal joint and the base of the corresponding proximal phalanx.

This disease is distinct from the pure shaft disease of the second metatarsus (Deutschländer) which often is associated with mild fever. It is very similar to the condition known as foot swelling of soldiers.

An analysis of a total of 63 cases reported in the literature shows that Köhler's metatarsal disease is found usually (80 per cent) in females and during the age of growth (94 per cent). Should the disease come under observation later, there is strong presumption that it had its origin during the growth period, because it frequently begins without causing any pain. Patients visit the physician only at the time when secondary arthritic changes cause them trouble. Adult patients, practically without exception, show such changes. The disease has apparently not been observed before the tenth year nor after the forty-eighth year of life.

Trauma very probably assumes a major secondary rôle in the etiology of this disease. Still the trauma is often so slight that it passes unobserved. A fracture is, however, always to be excluded. Strain deformities, as for instance, flat foot, may play a rôle equally important as trauma.

Further histological studies will be necessary to determine if embolic occlusion of an end artery can cause this disease. Some microscopic studies such as those conducted in a case described by the author indicate an embolic origin; but against this viewpoint is the striking incidence of this disease in the female sex. The latter fact might incline one to the view that some constitutional anomaly may be responsible. On the other hand, the possibility remains that the disease may be caused by various etiological factors. It is a question whether general diseases like rickets or tuberculosis have a predisposing tendency. An endocrine disturbance has as yet not been demonstrated in any of the cases reported.

To the same disease group probably belong Perthes' and Schlatter's disease, Köhler's disease of the os naviculare and possibly the change of the capitulum humeri described by Kappis, to which might be added other epiphyseal and apophyseal diseases during the growing period, which also prefer one of the sexes. Köhler's disease of the head of the metatarsus does not appear to be uncommon, and many cases undoubtedly must have been treated under a false diagnosis. To avoid error it would be highly desirable to have a distinct name for this condition which corresponds to the pathological nature of the process.

A list of 86 references is appended.

Sonntag. On Köhler's disease of the head of the second metatarsus. *Münchn. med. Wchnschr.*, 1922, lxix, 1567–1569.

Brief descriptions are given of two cases occurring in girls, one aged fifteen and the other thirteen years. The roentgenogram in the first case indicated a well-developed stage of the condition, while in the second case it was in the early stage.

In the first case the head of the metatarsal of the right foot was shortened and thickened. The articular end appeared squeezed in and the surface was flat instead of a convex curve, and was somewhat irregular. The trabecular marking in the whole head was distorted and filled with a variety of irregular scattered areas of condensation at the articular end. The cap appeared somewhat contrasted and split off. At both lateral corners there were signs of a ragged, marginal proliferation. In addition the proximal phalanx of the second toe was flattened and somewhat irregular at the articular surface. The articular space was distinctly widened. The diaphysis was somewhat broadened at its

distal end, had a somewhat shortened neck, was denser and appeared coarser than the corresponding member in the left leg. The cortex, at least in the distal half, was somewhat thickened. In the lateral picture the epiphysis was bent somewhat dorsally.

In the second case the roentgen picture showed the head of the metatarsal in the left food slightly shortened and rather more broadened. The trabecular marking in the head was quite distinctly distorted. There was distinctly evident a small area of rarefaction and several areas of slight condensation. The joint space appeared perhaps slightly widened. The distal portion of the neck of the second metatarsal appeared to be slightly broader than normal.

The author presents a brief summary extracted from the literature under the following headings: incidence; localization; age; sex; symptoms; roentgenology; diagnosis; histology; etiology; prognosis and therapy.

The following is his summary of the roentgenological aspects: The head of the metatarsus is shortened and thickened, eventually by one-half. The articular end appears to be pressed in. The articular surface instead of being convexly oval is flat across or slightly S-shaped and at the same time irregular. Throughout the whole head of the bone the trabecular marking appears distorted and frequently scattered with areas of rarefaction and condensation. The bone cap is frequently separated into several pieces and appears as if crushed, often containing what appear to be sequestra. Changes are often observed, especially in older cases, as secondary phenomena which resemble arthritis deformans. These take the form of marginal proliferations and lacunae most predominantly in the head of the metatarsus and often at the base of the proximal phalanx. The articular space appears widened (up to twice the normal) and irregular. One case is reported in the literature in which this space is narrowed. The diaphysis of the metatarsus is broadened in the distal portion and without a neck. Its cortex is thickened, sometimes to a small extent but in any event, demonstrable microscopically. Another roentgenological change seen is bending of the diaphysis dorsally; but it appears to be absent in some cases.

Regarding the technique of roentgenography, it is stated that as a rule an exposure of the metatarsus taken from above usually suffices. It is necessary to examine all the metatarsi in both feet since the condition may be found in other metatarsi besides the second. A lateral view may be useful to demonstrate the dorsal bending of the head.

SCHREUDER, O. Can the disease of the second metatarsus (Köhler) be the result of a chronic trauma? *Deutsche Ztschr. f. Chir.*, 1923, clxxviii, 145–159.

The author has observed 3 cases, which are described. These occurred in girls seven, sixteen and sixteen years old, respectively. The symptoms and courses in these cases were typical.

Two factors that are considered of importance in the etiology of this condition are: (1) flattening of the horizontal arch (pes transversoplanus), and (2) the use of high heels by young girls and women. These produce a strain upon the second metatarsus, which becomes virtually a continued trauma. If the bone does not adapt itself by hyperfunction under the strain, the consequences of the continued load are obvious. This affection of the second metatarsus can hardly be classed in the group with Osgood-Schlatter's disease, Perthes' disease and Köhler's disease of the os naviculare pedis for the following reasons: There is no anatomical evidence of an abnormal bone nucleus anlage of the epiphysis of the second metatarsus. Moreover, only the distal third of the head of the metatarsus is involved and not the whole epiphysis, as is the case in Perthes' disease. The time of appearance of the disease does not occur as in the above mentioned diseases at the time of greatest development of the epiphyseal nucleus, but appears subsequently. In the three cases described by the author the disease appeared after the epiphyseal lines of the involved bones had already become calcified.

The author is not convinced by the explanation of Axhausen that this disease is caused by an embolus followed by necrosis. It is claimed that there are no end-arteries in the spongious bones of the epiphysis and moreover that there is no histological evidence of anything analogous to a tuberculous alteration. Even Axhausen notes certain deviations in the pathological picture of the injured second metatarsus from those found in Perthes' disease. The author adheres to the view that the real explanation of Köhler's disease of the second metatarsus is to be found in chronic trauma.

AXHAUSEN, G. The pathological process in Köhler's disease of the head of the metatarsus and in Perthes' disease of the head of the femur. *Zentralbl. f. Chir.*, 1923, l, 533–558.

There is agreement in the roentgenological findings in Köhler's disease and Perthes' disease. In both conditions the roentgen finding

in the first stage is negative, and in the later stages similar roentgenological changes are observed. There is flattening of the joint surfaces which appear as if crushed together, focal condensations surrounded by areas of rarefaction, thickening of the metaphysis and finally, a joint deformation of the end of the bone. These facts would indicate that certain pathologico-anatomical factors are common in both diseases, and that the essential factor is an epiphyseal necrosis.

There has been little opportunity to make a histological examination in an early case of Perthes' disease, and only recently an opportunity came to make such an examination in collaboration with Freund. The details of this examination are not given here, but the important point disclosed was a total necrosis of the whole epiphysis (bone and marrow), a partial necrosis of the partly eroded joint cartilage, and complete immunity from involvement of the epiphyseal cartilage and metaphyseal bone which were entirely intact. A break in continuity of the epiphyseal cartilage was nowhere present. On the other hand, the dead epiphysis in the upper region of the free joint space indicates a superficial impression fracture with beginning maceration of the fragments. The necrotic epiphysis showed the beginnings of osseous replacement. There was no sign of leucocytic infiltration, nor was there a trace of tuberculosis.

This description of the early pathological picture in Perthes' disease finds its analogue in the descriptions of the second stage in Köhler's disease.

The author points out that the necrosis in these diseases is a definitely established fact, but an explanation of the origin of these necroses is still a matter of speculation. He has suggested the mycotic embolus theory merely as a possibility, without claim for actuality. Further observation and experiment is necessary to prove or disprove its existence.

Kappis, Max. The cause of Köhler's disease of the head of the second metatarsus. *Beitr. z. klin. Chir.*, 1923, cxxix, 61–70.

Another case is reported by the author, in a girl aged seventeen, where an opportunity was afforded for histological examination of the resected bone. This examination disclosed that more than two-thirds of the area of the joint surface of the metatarsal head was depressed from a few up to 6 mm. below the normal level. In this area there had developed, between the cartilaginous cover and the bone, a new layer of tissue partly connective and partly chondroid. The cartilage bone boundary was found for a distance of 11 millimeters to be adherent to the cartilage cover, and consequently above this connective tissue layer, while the other portion (about 12 mm.) lay above the bone but below the connective tissue layer. In the latter area the beginnings of the bony structure were found as much as 6 mm. below the normal surface. All signs of inflammation, embolus, thrombosis, tumor, osteitis fibrosa, or any other disease were absent. The pathological-anatomical picture suggests fracture as the primary injury.

It is the author's belief that this constitutes the only actually demonstrated cause for the disease, namely, fracture of an apparently healthy bone. The absence of a history of trauma cannot weigh very much, because in one of the author's cases the pathological picture was one of fracture, while no history of trauma could be elicited from the patient. This fact would suggest that possibly avitaminosis, late rickets or similar conditions that weaken the osseous system may be primarily responsible.

Consideration of Perthes' hip disease suggests that possibly here also there is a sudden, or stepwise or else gradual fracture of the head of the epiphysis. Such an assumption would explain all the anatomical and clinical observations thus far reported. Such a breakdown can occur with or without trauma, and the manner of healing fits in with the theory of fracture. When one observes many roentgenograms of the heads of the femurs in children and sees the most diverse irregular rarefactions in the osseous nuclei of the femur heads, the possibility of the traumatic-mechanical infraction of this bone does not appear to be so unbelievable, even in a previously normal bone.

Caffier, P. Regarding the pathogenesis of Köhler's disease. *Monatschr. f. Kinderh.*, 1923, xxiv, 810–812.

A description is given of a case in a boy aged six and three-quarters years. This child had been run over by a wagon six months previously and had received a rather painful injury of the left leg. The original wound had been treated, and healed by first intention, and there was complete recovery of function. Six months after this injury he again presented himself with a callus exostosis at the base of the fifth left metatarsus. The roentgen examination disclosed a change in the nucleus of the os naviculare. This change consisted of a condensation, a narrowing of the sagittal section and a splitting—characteristic of Köhler's disease.

The callus exostosis was removed by operation. Roentgenograms taken two or three months later showed an increase in width of

the ossification center of the naviculare, with an approach to the normal shape present on the unaffected right side. These signs of recovery were unaccompanied by any proliferations of periosteum or callus. In this particular case there were no very pronounced local symptoms or disturbances in function.

The author inclines to the view that trauma must play a considerable part in the etiology of Köhler's disease. Usually Köhler's disease is associated with a local disturbance of ossification, this disturbance being due to certain external and internal causes. The external causes include all traumatic insults, either direct or through injury of the blood vessels and disturbance of nutrition. Of 54 cases in the literature, there were at least 21 in which trauma was definitely elicited in the history. The fact that boys are affected about twice as often as girls, and that strong as well as weak children can show the symptoms of Köhler's disease is regarded as further evidence in favor of trauma.

Internal factors play a part in the etiology. These may be of congenital origin or due to diseases, such as rickets.

The author recognizes that in the case above reported it is quite possible that the finding of Köhler's disease was merely incidental to the primary trauma and not caused by the latter.

HÜHNE, THILO. Histological findings in so-called malacia of the semilunar bone and in the second Köhler's disease. *Beitr. z. klin. Chir.*, 1924, cxxxii, 226–243.

A report is given of the microscopic findings in 2 cases of so-called lunatum malacia and 2 cases of Köhler's disease of the metatarsophalangeal joint. In all these cases the pathological anatomical picture in the cartilage and bone was that of well-developed arthritis deformans. This included degenerations of cartilage, and the proliferation of marrow and blood vessels through the zone of calcification into the uncalcified cartilage. There were also present marginal formations, and infractions of the joint or epiphyseal cartilage with fields of débris below or above the sites of infraction; the fields of débris contained necrotic areas.

There are two ways to explain the development of the arthritis deformans: (1) the primary process may be the degeneration of cartilage, such as is the case in arthritis deformans as ordinarily observed; (2) the primary condition may be fracture or bone necrosis, with arthritis deformans developing secondarily. A variety of considerations would seem to indicate that in the cases above discussed the arthritis deformans changes had developed before the infractions and the necrosed areas.

In the various histological descriptions published, evidence of arthritis deformans changes was absent only in one case of Köhler's disease described by Kappis, in the cases of Köhler's described by Fromme and in those of lunatum malacia reported by Guye. Theoretically, the possibility cannot be excluded that such arthritis deformans changes might perhaps have been discovered if serial sections had been taken of all the affected zones.

HODGKINSON, H. R., and DUKE, L. S. Discussion of Köhler's disease, with report of a case. *Med. J. Australia.* 1924, Volume II, 11th year, 553–554.

A brief report is given of a case occurring in a boy aged six, who limped and complained of pain and swelling on the inner side of the left foot. A swelling 5 cm. long, and 2.5 cm. wide and 2.5 cm. in elevation was visible over the navicular region of the left foot. There was localized tenderness over the navicular bone. Neither heat, redness nor pain was present. The roentgen-ray examination revealed the presence of Köhler's disease. Roentgenographically, the bony nucleus is seen to be smaller and denser than usual, and as a rule regular in outline though it may be fragmented. The increase in density may mean either hypercalcification or true osseous sclerosis. It is supposed to be due to increase in the fully formed bone. The exact etiology is unknown. The excessive calcification of the altered navicular bone may be regarded as a defense reaction of the bony tissue to a chronic infection. Or else, the infection may cause a disturbed balance between osteoblastic and osteoclastic activity. Infection is particularly liable to attack newly forming bone, especially when the latter is subjected to trauma. Its localization in the damaged osseous nucleus of the navicular bone may be due to the fact that this bone commences to ossify later and is thus more liable to infection during its early ossification than the other bones of the tarsus.

In the case above described, the boy had suffered with an impetiginous eruption of the legs eight months previously. It may be that the host was suffering from a mild chronic infection and the organism was of a low grade of virulence.

GREENWOOD, H. H. Köhler's disease of the tarsal scaphoid. *Lancet, Lond.*, 1923, ii, 274–276.

In this disease the symptoms and physical signs are not obtrusive, spontaneous recovery

seems to be the rule and the precise diagnosis rests on the characteristic roentgenographic appearances. It is probable, therefore, that the disease often escapes detection and that it is more common than records indicate. The clinical picture is fairly clear cut, although in details there are some differences of opinion.

The disease occurs in young children, most frequently in boys between three and ten years old. The onset is usually insidious, sometimes sudden, with pain and swelling in the region of the tarsal scaphoid. The general health is usually indifferently good. The roentgenographic findings are: (1) the affected bone is smaller than normal (one-half to one-fourth size); (2) the outline of the bone is irregular; (3) the density of the bone is increased (perhaps two to four times); (4) the normal architecture of the bony trabeculae has disappeared; (5) the general shape of the scaphoid is altered, being more flattened anteroposteriorly and not widened from side to side. There is considerable diversity of opinion as to the etiology. It is suggested that a review of the clinical data is necessary in view of a renewed possibility that tuberculosis may actually be at the bottom of this condition.

A case is described in a boy five years and ten months old who was the subject of a latent, mild tuberculous affection, which lighted up (probably through an injury of moderate severity), a smoldering tuberculosis of the scaphoid bone of the foot. The early stage, evidenced by a rarefying osteitis, gave rise to such trifling clinical signs that no complaint was made; and no roentgen examination was carried out so that the disease escaped recognition. If the disease had spread to neighboring bones it would be diagnosed as a frank tuberculosis of the tarsal bones, but with resolution occurring and a reparative sclerosis taking place the roentgenogram disclosed the condition called Köhler's disease. The author states that it is natural that recovery in Köhler's disease should "always occur" since the disease is already recovering when detected.

De Gaetano, L. A case of Köhler's disease of the scaphoid bone of the tarsus. *Ann. ital. di chir.*, Jan.–Feb., 1925, iv, 52–79.

A case of this disease is described in a boy aged five, who had had a fall three months before. Even before the accident his parents said that he had sometimes complained of pain in the left foot in the evening. On examination there was pain on pressure and slight edema over the scaphoid bone of the left foot. Active movements were limited; passive movements almost normal. Roentgenological examination showed decreased size of the left scaphoid as compared with the right, and greater opacity of its shadow. The foot was immobilized in a plaster cast and in four months the child was clinically cured. A series of roentgenograms taken during this period showed progressive decrease in the hypercalcification of the diseased scaphoid.

This disease generally occurs in children from five to nine years of age, three-fourths of the patients being boys. The predisposing anatomical causes are retardation of ossification and defective nutrition because of poor blood supply; the scaphoid at all periods of life is very poorly vascularized. Moreover the scaphoid is very much exposed in all movements of the foot and in falling, as it forms the keystone of an arch. Predisposing general causes of the disease are hypothyroidism, late rickets and anomalies of development of the bone, for example disturbance of the process of enchondral ossification at the boundary between bone and cartilage. But such general predisposing causes are not so important as the local ones of inflammation and trauma. Inflammation from infection is by no means always present and trauma is by far the most frequent cause. The patient does not always report a trauma, but sometimes it may be a question of slight and frequently repeated trauma which passes unnoticed but which causes compression and contusion of the bone substance with slight ruptures of the capillaries, effusion of blood and necrosis of cells. In the cases that have been examined histologically there has always been necrosis. The primary feature in Köhler's disease therefore is a necrotic process, brought about generally by trauma; calcium salts are always deposited in tissues whose vitality is decreased and this accounts for the hypercalcification which is the most prominent roentgen sign of the disease. This is followed by a process of atrophy and sclerosis, causing the second roentgen sign of decreased size of the bone.

Heitzmann, O., and Engel, H. Epiphyseal diseases during the years of growth (osteochondritis deformans coxae juvenilis and Köhler's disease). *Klin. Wchnschr.*, 1923, ii, 397–399; 444–446.

In order to obtain a better understanding of the disease processes occurring, detailed histological studies were made in one case of Köhler's and 2 cases of Perthes' disease. These findings are illustrated and described in detail. The common cause of Köhler's and Perthes' diseases is a primary necrosis of the epiphysis without primary injury to the cartilage cover. All other changes are to be regarded as secondary. In this class belongs the deformation, which in the Köhler's case, prob-

ably because of protected anatomical position, was only very slight, while in both cases of Perthes' disease there was extensive deformation whereby the joint cartilage following disappearance of the epiphysis lay in spots directly upon the epiphyseal cartilage. Under the abnormal load, which now is transferred almost directly upon the epiphyseal cartilage, the latter becomes yielding and gives way so as to resemble an infraction. The gap in the epiphyseal cartilage is filled in the direction of the diaphysis with new osseous tissue rich in cells, vessels and fibers (callus) which in the second case of Perthes' disease led to cyst formation owing to a central softening. The findings of arthritis deformans also belong to the group of secondary changes.

Observations extending over several years upon 20 cases of osteochondritis in younger and older persons have developed no definitely new viewpoints as to etiology. The pathological studies on these 3 cases give little ground for support of the theory of an inherited defect.

The disease may be traced through three phases. At the commencement there is flattening and roughening of the head, in severe cases complete collapse and separation of the epiphyseal nucleus and finally development of the well-known cylindrical shape of the head of the bone. Pathologico-anatomically there is a partial or complete increase in the epiphyseal spongiosa of the growing bone. Under static load, the softened epithelium flattens out and the cartilaginous covering accommodates itself to the new shape without considerable injury. The epiphyseal line begins to show proliferation. Reparative processes, revival and osseous reconstruction of the necrosis explain the further break-up of the epiphyseal line and the formation of bone islands. The foci observed under the epiphyseal line are to be regarded either as necroses in the process of restitution or as secondary infractions of the spongiosa caused by mechanical load, which make themselves evident by callus-like masses. Osteitis fibrosa is not present. Primary injuries to the cartilage in the sense of Axhausen were not demonstrable in the 3 cases here described. One is justified in identifying the juvenile form of arthritis deformans with osteochondritis. True arthritic changes may be demonstrated, if not in the joint cartilage of the head, at least in the marginal proliferations and in the changes in the acetabulum and the capsule.

SCHROEDER, L. C. Survey of tarsal scaphoiditis. *Am. J. Dis. Child.*, 1924, xxviii, 293–300.

Tarsal scaphoiditis occurs in children between the ages of four and nine years, and in boys more frequently than in girls. The diagnosis cannot be made without a roentgen-ray examination. The cause of the disease may be due to repeated slight trauma to a delayed ossifying center. The symptomatology and course are practically the same in all cases and the prognosis is excellent.

The roentgenogram shows definite changes in the scaphoid bone. This bone is diminished in size; the outline is irregular and the contour instead of being clear cut is blurred and irregular. There is a decided increase in density due to an abnormal calcium content. The time for full recovery may be two years, but roentgenograms taken after recovery is complete show a fully and perfectly developed scaphoid.

A case is described in a boy aged five in whom there was only a negligible history of trauma. The boy had a temperature of 102°F. and it was decided that he had rheumatic fever. The boy was kept in bed for about five months. When seen at this time there was atrophy of the right leg, fullness and tenderness over the dorsum and internal part of the right foot and limitation of extreme dorsal flexion, abduction and adduction. Physical examination was otherwise negative. A roentgenogram taken at this time showed the typical picture of Köhler's disease. The foot was put in plaster, and the patient was allowed out of bed, after which improvement was rapid and in a year the scaphoid showed a perfectly normal appearance.

KIDNER, F. C., and MURO, F. Köhler's disease of the tarsal scaphoid or os naviculare pedis retardatum. *J. Am. M. Ass.*, 1924, lxxxiii, 1650–1654.

There are two distinct pathologic entities to which the name of Köhler's disease has been given. One of these occurs in the head of the second metatarsal and the other in the scaphoid of the tarsus. This paper deals only with the condition as seen in the tarsal scaphoid. An accurate descriptive name suggested for this condition is os naviculare pedis retardatum.

A typical case of this disease was observed in a boy aged eight. The case is described and illustrated with roentgenograms. The general picture is that of bone subjected to interference in normal development. This interference might be due to congenital defect, lack of blood supply or to infection. A similar condition is seen in Legg-Perthes' disease.

In the roentgenogram the bony nucleus of the scaphoid appears denser than normal. It is decreased in all diameters and ragged in outline. The anteroposterior diameter seems to be shortened more than the side to side diameter. This is probably not a fact but an illusion due to the great disproportion between the two diame-

ters normally. There is moderate swelling and thickening of the soft parts. The surrounding bones all throw normal shadows and there is no notable calcium absorption. The increased density of the scaphoid nucleus is apparently due to a decrease in size of the canaliculi with consequent shrinking or compression of the lime containing bone elements. The density does not seem to be due to actual increase in the amount of calcium salts. Sometimes there is a tendency to fragmentation of the nucleus, which however never breaks up into separate elements.

After consideration of all the evidence, the authors are forced to conclude that Köhler's disease is an interference with the power of bone production in the scaphoid of the foot. This interference is due to low grade infection, the source of which is unknown. The scaphoid is attacked because the bone in the arch of the foot bears the greatest strain and because it has the poorest blood supply of any of the bones in the tarsus. Trauma undoubtedly has an influence in making the scaphoid susceptible to the infection. The infection is so mild that ordinarily it is overcome by the resistance of the body and development goes on with an approach to the normal. It is believed that this is true also in Legg-Perthes' and Schlatter's disease.

LANE, T. J. D. The coincidence of pseudo-coxalgia and Köhler's disease in the same patient. *Lancet, Lond.*, 1924, ii, 369–370.

Two cases have been observed which tend to confirm the French view to the extent that there is not merely a roentgenographic resemblance but also an etiological connection between pseudo-coxaliga and Köhler's disease; evidence of apophysitis of the tibial tubercle was, however, absent in both cases.

The first case occurred in a boy aged eight. The roentgen examination of the right hip showed flattening and fragmentation of the epiphysis with isolated dense areas within it. The neck of the femur was expanded. The left scaphoid was reduced to a thin disc, fragmented and showing a dense area within its substance. The left hip, both tibial tubercles, right foot, and both wrists were normal. The clinical examination of the left foot failed to show anything abnormal, and the roentgenogram alone enabled discovery of the condition of the scaphoid.

The second case occurred in a boy aged four and three-quarters years. The roentgen examination of the right scaphoid showed a thin disc, fragmented, with a dense area within it. In the right hip the normal curvature of the articular surface of the epiphysis of the femur was lost. The epiphysis was flattened and angular. The neck of the femur was expanded. In this case the roentgenogram gave considerable weight to the clinical findings in determining the diagnosis.

These two cases tend to support, but of course do not prove the theory that the roentgenographic and clinical resemblance of Köhler's disease to pseudo-coxalgia is explained by a common etiology. The two children were too young to suffer from Schlatter's disease; and further study will be necessary to establish or disprove a connection between this condition and Köhler's disease and pseudo-coxalgia.

V. DITTRICH, KLAUS. Osteochondrolysis traumatica (König's osteochondritis dissecans of the knee); clinical and histological study. *Virchow's Arch. f. path. Anat. (etc.), Berl.*, 1925, cclviii, 795–819.

A report is given of 2 cases. The first occurred in a young man aged seventeen, who presented a high grade genu valga. The roentgen examination of both knees showed an abnormally shaped tibial epiphysis from which the eminences projected upward in an unusual manner. The epiphyseal junction showed rachitic changes, and the calcification in the region of the medial portion of the epiphyseal line was rather scant. The metaphysis was considerably enlarged in the left knee and there had resulted a pathological apposition of the axes of the tibia and femur. The medial condyle showed a defect half the size of a hazelnut. This was bilateral and located symmetrically in the anterior angle of the knee in the medial condyle. It had the same size and position in the right and left knees, and had a relatively sharp outline with walls slightly dense. Both of these defects showed sequestrum-like inclusions in their interior. The left hip showed a pronounced lengthening of the neck of the femur, and bending to correspond to the valgus position. The heads of both femurs appeared uniform and quite smoothly outlined. The diagnosis was rachitic genua valga and bilateral osteochondritis dissecans of the knee.

The second case occurred in a man, aged twenty-two. The roentgenogram of both knees showed at the medial condyles of the femur, somewhat toward the intercondylar depression, the presence of a rather large, uniform defect about one centimeter deep. The one on the right was surrounded by slightly reactive bone and both contained a large body of uniform bony density. In the left knee this joint body hung down somewhat and showed signs of constriction. On the left side there were, in addition, distinct signs of arthritis deformans, but no rachitic residues were evident.

Both of these cases were operated upon and the resected tissues subjected to histological

study. The pieces removed were from the insertion of the ligament. The important histological characters are as follows: There are distinct areas of destruction and fragmentation with hemorrhages around the subchondral and chondral portions of the focus. These changes may be definitely regarded as results of trauma. The subchondral region shows more extensive destruction than the joint cartilage. The granulation tissue has quite a distinct differentiation and shows various characters such as edema, hemorrhage, etc. The old cartilaginous and osseous portions of the focus, as well as those generated by the reaction, show well-staining nuclei throughout, which is proof of the life and function of the tissue cells. Secondary tissue death prevails only as a purely local phenomenon in the small areas of fragmentation.

AXHAUSEN, G. Regarding osteochondritis dissecans of König. *Klin. Wchnschr.*, 1924, iii, 1057–1060.

In a variety of diseases of the skeletal system known for a long time but not explained pathologically, the primary anatomical condition consists in an aseptic necrosis of the epiphyseal bone and the epiphyseal marrow as a result of mild injury to the joint cartilage or even without such injury. These diseases termed "epiphyseal necrosis" include osteochondritis deformans coxae of Perthes, Kienböck's lunatum-malacia, Köhler's disease of the head of the metatarsus and of the os naviculare pedis. In all cases the end result of the primary epiphyseal necrosis consists exclusively in the initiation of an intense regenerative cell proliferation in the adjoining living tissues. In this there is participation of the metatarsal periosteum, of the penetrating synovial membrane and the metaphyseal marrow.

The mechanical effect of pressure resulting in a pronounced loosening of the dead subchondral portion of the epiphysis gives an end result corresponding to the anatomical findings and description given by König for osteochondritis dissecans, and is the result of an aseptic epiphyseal necrosis. The views of König on the internal relation between the causal epiphyseal necrosis and the subsequent process of localization require some correction on the basis of recent histological observations. The localization process is not the immediate and natural result of the necrosis. The assumption that this necrosis of itself initiates the inflammatory localizing process is inadequate. The natural result of the necrosis is the bony substitution resulting in complete reorganization. It is only the pathological compression fracture of the dead epiphysis with the formation of a wall of bone débris which interferes with bony substitution and forces the process of localization to appear. This process of localization or delimitation has been found responsible for the free joint bodies of the knee, and elbow which König originally observed.

AXHAUSEN, G. Experimental joint fractures and infractions. *Arch. f. klin. Chir.*, 1923, CXXIV, 543–553.

The mode of formation of free osseous bodies in a joint capsule following injury is still a matter of speculation. Efforts to produce such formations in the experimental animal by violent blows over the patella have been uniformly unsuccessful. Even the most violent blows with a heavy hammer upon the flexed knee failed to produce any impression fracture. It therefore became necessary in order to study this matter to produce the desired trauma by operation. Such experiments were performed on rabbits and dogs and the tissues were subjected to careful histological study.

In all experiments in which there was a break in continuity between the injured area and the shaft of the bone, whether by impression fractures or by chiseling out a section of the bone and replacing it, the healing process in the bony portion proceeds according to the well-known processes characteristic of the bony system in general. There was a very rapid osseous welding and mortising of the separated surfaces, a rapid replacement of the dead marrow tissue and dead bone by a corresponding new tissue. In a very short time there is an extensive restoration of the original condition. On the other hand, the present experiments show the slight tendency to healing of the bone cartilage. Cartilage sharply separated or sliced away remained unchanged even in the longest of these experiments (three months). Cartilage lacunae become only incompletely filled with subchondral connective tissue and in cartilage debris the necrotic portions are resorbed by the subchondral connective tissue. With the replacing connective tissue is associated fibrous cartilage which finds its origin in the residual proliferating cartilage cells.

These experiments leave unexplained the traumatic genesis of free articular bodies.

New observations in another phase of joint pathology may perhaps explain the riddle. If in Köhler's disease of the head of the metatarsus and in Perthes' disease of the hip epiphyseal necroses represent the primary pathological condition with which are associated breaks in continuity due to pathological fractures, and if, as is actually the case, the histological picture of the resulting sequelae

of such spontaneous fractures agree with the findings in many of the joint bodies in the process of development, then one must consider the possibility that a similar relation is also present in the development of these joint bodies, namely, that we have here not impression fractures of the normal joint surface but pathological fractures of dead epiphyseal bone, together with the characteristic consequences of such injuries. It is the author's belief that the primary cause of interruption of the epiphyseal nourishment is a mycotic embolic necrosis, unassociated with infection or else associated with a quickly overcome infection.

Delahaye, André. Étude sur quelque diagnostics de mal de Pott en particulier sur l'epiphysite vertebrale de croissance. Theses pour le doctorat en medicine. Travail de l'hôpital Maritime de Berck, Paris, 1924.

The clinic, aided by the roentgenogram and the laboratory, permits of differentiation of a series of affections of the spinal column formerly confused with Pott's disease. The syndromes are sometimes very close to tuberculous osteo-arthritis of the vertebrae, of which the symptomatology is often variable. However, the clinician mistakes these conditions for Pott's disease very often. It is possible to isolate: vertebral malformations frequent in infants; a series of vertebral traumatisms frequent in the adult; chronic vertebral rheumatism. In all these the roentgenogram shows a valuable agreement: (1) absence of signs of vertebral osteo-arthritis; (2) positive signs special to each of these affections. The diagnosis of syphilitic vertebral osteo-arthritis is extremely delicate. Only the rapid efficacy of intensive treatment permits of affirming this diagnosis. In all the varieties of painful syndromes in the spinal column of acute or subacute infections, the roentgenogram and the laboratory define the problem by eliminating Pott's disease. Deep study of the clinical examination of antecedents with the abnormal evolution of the affection permits of diagnosis. Outside of these, certain affections are difficult of diagnosis, are obscure and difficult to classify. Among these there is a form special to adolescents: vertebral epiphysitis characterized by the age at which it appears. Slight infection seems to be the cause. The cases are most often of benign origin; however the origin may be certain forms of vertebral insufficiency.

Lewin, Philip. Vertebral epiphysitis. *Ann. Surg.*, August, 1925, lxxxii, 286–288.

Vertebral epiphysitis is a definite pathological entity and is analogous to Legg-Calvé-Perthes' disease of the hip; to Osgood-Schlatter's condition in the upper tibial epiphysis; to Köhler's tarsal scaphoiditis; to Freiberg's infraction of the metatarsal head; to carpal epiphysitis and to apophysitis of the os calcis.

The etiology involves local or remote infection, circulatory disturbance in the nature of embolism, thrombosis, etc., trauma, both internal and external, and glandular disturbance affecting bone growth and development. The symptoms are similar to those of early tuberculosis. The course of the disease is comparatively short and prognosis is excellent if proper treatment is instituted. Heliotherapy is valuable and if properly given is probably the only treatment necessary, except a simple spine support.

Roentgenographically, anteroposterior and lateral views reveal the characteristic involvement in the region of the epiphysis. No exudate is seen. In the case reported the anteroposterior roentgenogram revealed what appeared to be bilateral double transverse processes of the fourth lumbar vertebra but which was in reality a fusion of two vertebrae, the third and fourth lumbar vertebrae having united. In the lateral view a definite line of fusion was visible at the junction of the upper and lower thirds of this composite vertebra.

Buchman, Joseph. Vertebral epiphysitis. A cause of spinal deformity. *J. Bone & Joint Surg.*, October, 1925, vii, 814–834.

An investigation was made of the relationship existing between the abnormal changes in the superior and inferior vertebral epiphyses and the acquired deformities of adolescence. Study was also made of these epiphyses in the normal spine, their normal appearance and the age at which they may first be seen in the roentgenogram. Normally the superior and inferior vertebral epiphyses appear at about eleven and a half years of age. They appear first in the lower dorsal region and then extend up and down the column as small triangular shadows adjacent to the anterior inferior and the anterior superior angles of the bodies. Later they become elongated and appear as thickenings placed anteriorly and thin linear shadows extending backward and terminating at the posterior angles of the bodies of the vertebrae where they become thickened. When seen in perspective these epiphyses appear as rings, thick peripherally and thin centrally. Normally the intervertebral spaces are clear and should present some degree of clarity all along the spine. Haziness, if any, is uniform in density and there is no mottling. Any gross deviation from these findings, whether in time of the appearance of the epiphyses or deviation in the order of the appearance, abnormal roent-

gen-ray findings or presence of tenderness is indication of a pathological condition.

The pathologic changes seen in the roentgenogram are as follows: The epiphyses become enlarged, moth-eaten, frayed and indistinct; the intervertebral spaces become cloudy, mottled and irregular; the vertebral outlines become indistinct and all of these parts then tend to fuse into one indistinguishable mass. This is followed by a stage of regression in which the process is reversed. These abnormalities are found in a disease entity occurring between the ages of ten and twenty-one, and characterized by symptoms of fatigue, backache and a tenderness of the epiphyses, together with characteristic roentgenographic findings. Many of these cases develop deformities of the spine which present different findings from those given by deformities of the spine due to known causes.

The etiology of this condition is unknown but there is evidence leading to the belief that the condition is due to very low grade infection in the spine. Stress and strain constitute additional factors which aid in the production of deformity. The condition is analogous to Legg's disease, Osgood-Schlatter's disease, Köhler's disease and similar conditions and forms part of a greater entity: multiple epiphysitis of adolescence.

An examination of 120 unselected cases of various spine affections was made and out of 65 so-called idiopathic posterior curvature and lateral curvature 54, or 83 per cent, showed positive evidence of this type of epiphyseal disease. There were 3 cases without any clinical spinal deformities which showed a similar involvement roentgenographically; 2 of these cases were symptomless. The latter show that the epiphyseal involvement is primary and not secondary to the deformity. Clinically, this condition seems to be a self-limiting affection involving the epiphyses of the spine, most commonly in the dorsal region. Brief histories are given of 5 cases.

SCHEUERMANN, H. Kyphosis dorsalis juvenilis. *Ztschr. f. ortbrop. Chir.*, 1921, xli, 305–317.

Kyphosis dorsalis juvenilis, so-called schoolchild kyphosis or muscular kyphosis, is apparently due to an affection of the growth process of the vertebrae between the body and the epiphysis and is not, as has been assumed, caused by an insufficiency of the back muscles. The character of the disease shows a distinct parallelism with Calvé-Perthes' disease, osteochondritis deformans juvenilis coxae, and may therefore be designated as osteochondritis deformans juvenilis dorsi.

The author studied several cases and the records of others in the Danish Orthopedic Institute, Copenhagen. There was a total of 105 cases, 92 being found in boys and 13 in girls, the preponderance of cases in boys being rather noteworthy. Most of these were in boys who had just finished school and had begun to enter various manual trades. Farm workers had the greatest representation.

In most of the cases the condition took up to a year to develop, but in several of them the maximum of symptoms was observed two months after a particularly severe strain. The individuals were usually of robust build and muscular.

If a patient with acute kyphosis is roentgenographed ventrodorsally in the supine position, nothing abnormal will be observed because shadows of the vertebral bodies are projected over each other. It is only with lateral roentgenograms taken with particular care that anything definite can be observed. During the first half year of the malady the lateral roentgenogram will disclose the fact that the vertebral bodies lying on the concave part of the curvature are distinctly lower ventrally than they are dorsally. This difference in height is evident in the middle of the spine so that the vertebrae become distinctly wedge-shaped to a much greater degree than the slight wedge-shape observed in the normal dorsal vertebrae. The epiphyseal layer at the front edge is no longer a small triangular shape, but a broad irregularly circumscribed area. The contours of the vertebrae show also an irregular indistinct line suggesting abnormal conditions at the line of growth. The vertebrae more distant from the involved section assume a more and more normal appearance.

Roentgen pictures in the later stage fail to show the broad circumscribed zone above described. One only sees the epiphyseal ring as a distinct, rather long shadow, with sharply limited edges which lie at the front surface of the wedge-shaped vertebrae, and the line of growth assumes, after a while, a less irregular appearance. A study of the roentgenograms taken in conjunction with the clinical features seems to exclude the idea that there is any "insufficiency" of the musculature responsible for this condition, but rather some growth factor in the bodies of the vertebrae.

A comparison with Calvé-Perthes' disease shows a complete parallelism with kyphosis dorsalis, the only difference being localization. The other symptoms and the roentgenographic appearances appear to be analogous.

An illustrative case is described in a boy aged sixteen.

Scheid, F. Regarding so-called apophysitis calcanei. *München. med. Wchnschr.*, Oct. 16, 1925, lxxii, 1792–1793.

A report is given of a case occurring in a boy aged thirteen. There was a cloudy rarefaction in the roentgenogram of the calcaneal process, and the apophysis showed an indefinite outline. The apophysis in general was densely calcified but contained areas of low calcification. The treatment consisted of rest in bed. After fourteen days the pain and swelling had disappeared and the boy was able to walk normally. The above symptoms, which first appeared in the left heel, then appeared in the right leg about eight weeks later.

In addition to the clinical and roentgenological features described, the disease has the following characteristics: It makes its appearance during the period of growth, and the symptoms appear simultaneously with the development of the nucleus of the calcaneal apophysis. The rather rapid disappearance of the clinical symptoms after rest in bed is in contrast to the gradual recession of the roentgenological changes. Another striking character is the rather sudden onset, usually in connection with some excessive strain of the foot.

Just as in Köhler's and Perthes' disease, this disturbance in ossification is confused with tuberculosis, but the clinical finding, together with the course, location, and roentgen picture all speak against tuberculosis. It is emphasized that the diagnosis, as in Schlatter's disease, is to be based not only upon the clincal and roentgenological findings but also upon the age and history. This disease probably has nothing to do with trauma, tuberculosis or osteomyelitis. Trauma may be involved secondarily but the primary condition is a sick or weakened apophysis. It would appear that the disturbance in ossification of the calcaneus belongs to that group of diseases which appear during the period of growth and may probably be the result of hormonal disturbances. The prognosis is good and therapy consists of rest in bed.

Lewin, Philip. Apophysitis of the os calcis. *Surg., Gynec., & Obst.*, November, 1925, xli, 579–582.

Inflammation of the cap-like epiphysis at the posterior portion of the os calcis is called apophysitis. It is fairly common in boys between the ages of nine and thirteen and is probably due to local external and internal trauma, and local circulatory disturbances affecting the epiphysis during the critical period of growth. The treatment consists of immobilization and relief from weight-bearing plus general hygienic considerations. The prognosis is excellent. The condition is analogous to Legg's disease, Köhler's scaphoiditis, Scheuermann's vertebral epiphysitis, Freiberg's infraction of the metatarsal head, and especially to Osgood's tibial epiphysitis.

Roentgenograms made in anteroposterior and lateral projection reveal irregularity of the apophysis with thickening in all directions. There may be clouding or partial obliteration of the epiphyseal line. Signs of acute infection are not prominent. One case is reported.

ROENTGEN DIAGNOSIS

Kappis, Max. On the origin of coxa vara adolescentium. *Zentralbl. f. Chir.*, 1925, lii, 292–297.

A case is described in a girl aged fourteen in whom the development of the coxa vara was entirely different from the types described in the literature. The complaint began with pains in the left knee and hip. The condition improved somewhat in a year and disappeared. At this time the roentgenogram showed a bilateral coxa valga and the metaphysis in the region adjacent to the epiphysis showed a distinct rarefaction about 0.5 cm. wide. There were no other signs to account for the condition.

It was noted about a year later that the left bone was shortened by 1.5 cm. and that the left trochanter was raised the same distance. The motility of the hip was normal except for a slight limitation of abduction. Ability to walk was normal except for a slight limp on the left side. The roentgenogram showed that the original coxa valga had become a form of coxa vara in the left hip, while the right hip showed the old coxa valga. It would appear that this left-sided coxa vara was caused by the driving in of the head into the metaphysis causing a shortening of the neck of the femur. It is a question whether this condition is properly described as a coxa vara. It is certainly not one in the strictest sense because the neck of the femur is not horizontal and there are no other typical symptoms. This case appears to be a traumatic coxa vara.

The roentgen pictures observed here are strikingly analogous to the mushroom shape of the neck of the femur sometimes caused by epiphyseal breakdown and sometimes as a result of Perthes' disease.

Lahey, Frank H. Diagnosis and treatment of biliary tract disease. *Boston M. & S. J.*, Nov. 5, 1925, excii, 857–862.

The history of bile tract disease may be and frequently is very atypical in character; common duct stones often exist in the absence of distinguishing clinical features. Deep jaundice

without pain and apparently due to malignant obstruction has twice been discovered to be due to silent stone, and exploration and thorough investigation of the ampulla of Vater is indicated in these cases. The author has little confidence in the Meltzer-Lyons method of duodenal drainage, either as to diagnosis or treatment of biliary tract disease.

The Graham method of visualizing the gall-bladder by the administration of tetraiodophenolphthalein appears to possess great possibilities as an aid to diagnosis in gall-bladder disease. Positive roentgen-ray evidence has definite value in diagnosis, but deductive or secondary roentgen-ray evidence is of but little value.

LANZILLOTTA, R. Roentgenography in renal tuberculosis. *Arch. ital. di urol., Bologna*, September, 1925, ii, 41–56.

Seven cases are reported with roentgenograms showing that in many cases it is possible to make a differential diagnosis between renal calculi and renal tuberculosis by means of roentgen examination. The shadows of renal calculi are generally homogeneous, compact, with clear outlines and variable in form, reproducing the form of the part of the kidney where they have developed. But the spots of renal tuberculosis are small, more or less rounded, not homogeneous, with dentate borders, clear with dark spots, close to each other giving the picture of "speckled kidney." These spots are caused by old cavities disseminated in the kidney, the contents of which have become infiltrated with calcium salts. In other cases the spots look like sacs filled with glue. In these cases the opacity is due to the deposition of phosphates in the caseous matter which fills the sacs. Interpretation of the pictures is difficult in some cases however. A case is cited in which the patient had suffered from violent nephritic colic and the roentgenogram showed a long shadow following the direction of the right ureter. A diagnosis of calculus was made. But operation showed renal tuberculosis and the shadow was caused by a tuberculous gumma of the psoas. In another case it was hard to interpret the appearance of the spots; the clinical signs indicated tuberculosis but operation showed calculus. Mistakes in interpretation are particularly easy in painful forms of renal tuberculosis where the clinical symptoms are in favor of lithiasis. Roentgen examination is therefore a valuable aid in the differential diagnosis of these two conditions but it should be supplemented by chemical, histological and bacteriological examination of the urine of the two kidneys separately.

MACCHIARELLA, BIAGIO. A case of congenital topographical anomaly of the intestine. *Radiol. med.*, January, 1926, xiii, 27–31.

A man, aged sixty, came for treatment for symptoms of nervous dyspepsia. A roentgen examination showed that the jejunum was on the right and the colon fixed on the left of the spinal column. The author considers this a case of incomplete development of the intestine and thinks it had nothing to do with the patient's symptoms which were due to intellectual overwork. Up to the third month of fetal development the whole of the intestine has a common mesentery and is not fixed to the parietal peritoneum; after that, torsion of the intestine begins and proceeds gradually until the intestine reaches its adult position. Numbers of cases have been described in the literature as ones of common mesentery which the author believes should not be so called because the different segments of the intestine, the duodenum, cecum, ascending colon, etc. are not free but fixed, showing that their mesenteries have become attached to the parietal peritoneum. This was true in his case and therefore he does not regard it as a case of common mesentery but simply one of anomaly due to incomplete torsion of the intestine.

MINGAZZINI, ERMANNO. The indications, technique and results of pneumo-kidney. *Arch. ital. di urol., Bologna*, December, 1924, i. 415–428.

Pneumo-kidney or pneumoroentgenography of the bed of the kidney consists in creating an interstitial emphysema in the fatty capsule of the kidney. The transverse process of the 2d lumbar vertebra must first be located, which Bianchini accomplishes by drawing a median line over the spinous processes from the costo-vertebral angle above to the ilio-sacro-vertebral angle below. At the boundary between the upper and middle thirds of this line a second one is drawn perpendicular to it and 4 cm. to the right or left of the midline on this perpendicular is the free end of the transverse process of the 2d lumbar vertebra. Experience has shown that the vertical line averages 21 cm. in length, so it is sufficient to measure a distance of 7 cm. from the upper angle. The patient, having been purged the day before and given a cleansing enema on the morning of the examination is placed on the table in ventral decubitus or slightly turned on the side opposite the one to be examined, so the viscera will fall forward. The needle is inserted over the site of the 2d lumbar vertebra, which may be calculated in slightly adipose subjects to be 5 to 6 cm. deep; the tip of the needle is then inclined slightly

upward and inward and pushed in 1 to 1.5 cm. farther. Care should be taken to inject into the perirenal fatty tissue and not into the pararenal space, though even this may give fairly good results. If the needle stops too superficially in the subcutaneous fat it will cause emphysema; if it punctures a blood vessel there will be a flow of blood; if it punctures a muscle, generally the psoas, there will be a dull, heavy pain in the muscle, and if it enters the pleura, which it rarely does, there will be pain. Oxygen or carbon dioxid, preferably the former, because it does not disappear so quickly in the tissues, should be insufflated to the amount of 300–700 c.c.

This method of examination is indicated in surgical affections which change the size, form or position of the kidney. It is contraindicated if there is a suspicion of renal or perirenal suppuration. It is particularly valuable in obese patients in whom roentgenography is not very clear. It may show the existence of a kidney when cystoscopy or functional examination of the kidney is for any reason impossible; it may be very useful in children. It shows the size and mobility of the kidney, especially when associated with pyelography, and helps to determine the extent to which the symptoms are caused by bad position of the kidney. It shows tumor of the upper pole, horseshoe kidney or caseous kidney. In reno-ureteral calculus it shows the site of the stone and distinguishes it better than other methods from pseudocalculus, enteroliths, appendicular calculi and calcareous deposits on the 12th rib. It shows the varying permeability to the rays of different sections of the parenchyma, as in sclerosis and lobulation, cyst of the kidney and polycystic kidney. It also helps to differentiate tumors of the kidney from other tumors, for example of the gall-bladder, cecum, etc.

The author has used the method in 30 cases and gives roentgenograms of three types of normal kidney, one of beginning hydronephrosis, one of torsion on its axis of a kidney with beginning tuberculosis, one of sclero-adipose perinephritis and two of bilateral polycystic kidney.

Montanari, Arrigo. Segmental dilatation of the small intestine without stenosis. *Radiol. med.*, December, 1925, xii, 801–805.

A case of extraperitoneal sarcoma in a boy aged sixteen is described and illustrated by 6 roentgenograms. The mass of small intestines was pushed toward the periphery and in the center was an area of shadow of lesser density than the surrounding loops of intestine, which did not show any movement. The roentgenograms were taken in series at intervals of about a minute. This inner sac still contained barium after twenty-four hours. The author diagnosed it as a cavity in the tumor which communicated with the small intestine. But the tumor proved not to communicate with the intestine and the central shadow proved to be a loop of dilated small intestine. The small intestine presented dilatations in several places without any signs of stenosis and without any adhesions to the tumor. The author had rejected the theory of dilatation from organic or spastic stenosis when he made the roentgen examination because the cavity remained filled so long after the rest of the small intestine was empty and because it showed no contractions. He was at a loss to account for this finding until he read Vespignani's work on the roentgen findings in Donati's cases of retractile mesenteritis of the submesocolic fossa in which there was dilatation of the small intestine at segments corresponding to the sclerosis of the mesentery. He thinks it possible that a retroperitoneal tumor may, by neoplastic infiltration of the mesentery, cause changes in the nerves capable of causing segmental changes in the lumen of the small intestine and thus give rise to the picture described.

Moreau, J., and Murdoch, J. Diverticulum of the jejunum. *Arch. Franco-Belges de chir., Brussels*, 1925, xxviii, 192–202.

The roentgenogram is the key to the diagnosis of diverticulum of the jejunum. The general symptomatology is so vague as to be uncertain in diagnosis. A personal observation is given in which the roentgenogram gave very clear pictures of the diverticulum and is most characteristic. Barium paste is taken before the roentgenogram is made; the dilated stomach, ptosis, etc., are distinguished easily, and also masses resembling bunches of raisins, which constitutes the diverticulum. Good illustrations are given.

Moretti, Luigi. Calculus of the ureter and intermittent hydronephrosis. *Arch. ital. di urol., Bologna*, December, 1924, i, 383–389.

A boy aged thirteen, had had a series of colics for the past four years, the pain being in the right hypochondrium and radiating to the inguinal region and testicle of the same side, associated with burning and itching at the meatus of the urethra and intense desire to urinate. This was sufficient to suggest the diagnosis of kidney calculus, and roentgen examination showed an oval shadow with its longest axis from above downward and a little toward the midline, measuring about 1 × 1.5 cm., with a peripheral circle a little denser than the nucleus immediately below the right wing

of the sacrum. This seemed to indicate that the central nucleus was made up of uric acid, phosphates or cystin with a rather thick coating of calcium oxalate. While the clinical symptoms indicated calculus it required the roentgen picture to show that the stone was in the pelvic portion of the right ureter and not in the pelvis of the kidney.

For about a year the colics had been more frequent and accompanied by the appearance of a tense and painful swelling just below the right costal arch; when abundant dark-colored urine was passed the swelling and pain disappeared. This indicated crises of intermittent hydronephrosis. One of these crises occurred while the patient was in the hospital. The tumor disappeared during the night and the boy reported in the morning that he had passed dark-colored urine frequently during the night.

The question remains as to whether the calculus of the ureter was primary or secondary. Apparently it was the latter, for in the beginning the symptoms had been those typical of kidney colic but at the period when the swelling developed under the right costal arch, the stone had evidently passed from the pelvis of the kidney into the upper portion of the ureter. It evidently ordinarily caused a partial occlusion of the lumen, but at times when there was increased diuresis or perhaps temporary congestion of the mucosa the partial stenosis became total, causing distention of the pelvis, with all its consequences. When the intrapelvic tension became great enough to overcome the obstacle the urine was discharged and the swelling disappeared. The dark-colored urine indicated that there was also some degree of hematuria.

The stone was removed by ureterotomy and the incision in the ureter sutured with three Lembert sutures, healing by first intention.

NEGRO, MARIO. An unusual incident in catheterization of the ureters. *Arch. ital. di urol., Bologna*, July, 1925, i, 561–564.

A patient was admitted to the hospital with attacks of pain, showing all the charactersitics of nephritic colic; functional tests of the kidney indicated left hydronephrosis which seemed to be due to a small ureteral calculus. But there was some doubt of the diagnosis of calculus as a catheter passed the ureter unobstructed and there was no sensation of friction. Therefore an opaque sound was introduced for the purpose of pyelography. The pyelogram showed the left kidney pelvis and ureter very much dilated, and the sound had turned on itself inside the ureter, at about the middle third of the lumbar tract, forming a loop 10 cm. long. The patient had not felt any unusual sensation. This shows the lack of sensitiveness of the non-inflamed ureter. As the function of the left kidney was destroyed it was removed; no stone was found. It is possible that there may have been a stone passed through the dilated ureter and was expelled unnoticed. The loop in the sound may have been caused by its striking a calculus or a fold in the mucous membrane of the ureter, which prevented its ascending further. It is possible that this occurrence is not so rare as it seems, as many catheterizations of the ureter are performed without a pyelogram being taken.

OCHSENIUS, KURT. The prognosis of tennis elbow. *Deutsche med. Wchnschr.*, Nov. 27, 1925, li, 1988–1989.

So-called tennis elbow does not necessarily always have a good prognosis. In the case described a marked arthritis deformans of the radio-humeral joint developed in spite of all therapy which in the later stages consisted of stasis and hot air treatment. During the prolonged period of observation (twenty-seven years) the condition not only failed to improve but became worse as was indicated by the roentgenograms.

The case was first observed when the patient was seventeen years old and had been playing strenuous tennis for two years previously. The symptoms led to the suspicion of tuberculosis of the elbow, and the patient received injections of iodoform-glycerine. It was possible to stretch the arm only up to 160°. There was distinct crepitation at the radio-humeral joint. The roentgenogram six years later showed no signs of tuberculosis. The articular surface of the radius was not entirely smooth, but somewhat irregular as if the cartilage was altered by an arthritis. A later roentgenogram taken twenty-six years after the primary injury showed that the irregularities of the middle portion of the head of the radius had not disappeared and that in addition the lateral portion had developed pronounced roughening and serration. There was also evidence of a small new osseous growth laterally in the joint capsule. It is undoubtedly true that tennis elbow involves other processes besides muscle tearing; and in those cases in which there is a tearing away of the articular ligament with involvement of the periosteum, such as evidently took place in the above case, a prediction of a favorable outcome should be made with caution.

PACETTI, ALESSANDRO. Roentgen picture of osteo-articular changes in gout. *Radiol. med.*, January, 1926, xiii, 1–5.

A case of gout in a man aged thirty-seven, is described with four illustrative roentgenograms. Acute attacks of gout are often not accom-

panied by any changes in the bones which are visible to roentgen rays, but roentgen examination may be of great value in showing gouty changes of the bones which are not visible externally, especially in chronic gout of the bones and joints. These are not only the ordinary changes, such as decalcification, the existence of osteophytes and changes in the outline of the joint surfaces, but others which are really characteristic of gout, such for example as vacuolization of the end of the bone, and incisuras of the outlines of the bone, either semicircular or in the form of a halberd. The number and extent of these incisuras may be such that they become confluent and result in the detachment of large fragments of bone. These features and the presence of shadows caused by calcareous infiltration of tophi give a roentgen picture pathognomonic of gout.

Palmieri, Gian Giuseppe. The curvature of the second part of the duodenum described by Busi. *Radiol. med.*, October, 1925, xii, 701–707.

The author discusses the curvature of the second portion of the duodenum first described by Busi in 1922, and concludes that it is not a roentgenological sign that has a uniform value. It is probable that, as Balli believes, it may be due either to a congenital excessive length of the second portion of the duodenum or to pressure of some sort exercised on this part of the duodenum, which is very mobile. The pressure might be caused by a large kidney, an echinococcus cyst or an enlarged gall-bladder. Or the curvature might be due to traction either from pancreatitis or from peritoneal bands. If the adhesions are strong enough to cause a marked stenosis of the curvature of sufficient traction on the segment just above it, the picture may be confused with that of pseudodiverticulum of the duodenum.

Cole describes a roentgenological picture based on the triad: (1) irregularity of the median contour of the bulb of the duodenum; (2) curvature of the second portion of the duodenum, and (3) insertion of the right flexure of the colon into the curvature in the duodenum. This picture is to be regarded as characteristic of adhesions between the organs of the right hypochondrium.

There are certain signs which may serve as guides because of the readiness with which they strike the eye of the trained observer and suggest further verification. The curvature of the second portion of the duodenum described by Busi and the high median gas bubble in the right flexure of the colon described by Bucky and Fuld as a sign of adhesions in the right hypochondrium may be regarded as such guides. With their aid the author has succeeded in clearing up the most diverse clinical syndromes, due undoubtedly to the presence of adhesions, as the symptoms stopped when the adhesions were freed.

Pazzi, Ermanno. Roentgenological interpretation of calcification shadows in the right hypochondrium. *Arch. di radiol.*, July–Aug., 1925, i, 586–590.

In roentgenograms of the right hypochondrium, or more properly speaking the hepatorenal region, a differential diagnosis must be made between hepatic and renal calculus. The usual differential signs given are that kidney calculi are small, always appear at the same point in the renal shadow, are clearer in dorsal decubitus, their projection is in general pretransvertebral, in profile they appear posterior and lateravertebral. Liver calculi are large, can be displaced freely in all directions, appear at variable places in the renal shadow, are clearer in ventral decubitus, their projection in general is subcostal and external, and in profile they are anterior to the spinal column and subparietal.

Two roentgenograms are presented in which it was very difficult to establish the diagnosis according to these signs. A latero-lateral picture showed the picture in front of the vertebral column, but roentgenoscopic examination showed it fixed in the position of the kidney pelvis so it was diagnosed as kidney stone, and operation showed a stone in the kidney pelvis in a normal position. With kidney calculus in a mobile or ptotic kidney, of course the sign of the calculus being beside the spinal column in the latero-lateral picture would have little value. A case is described in an elderly woman in whom the roentgenogram indicated a hepatic calculus because of the oval form of the shadow, its appearance (central transparent nucleus with a denser border around it), its position anterior to the spinal column in the latero-lateral projection and its smaller size and greater clearness in dorsovental projection, but it seemed too low for a liver calculus, being at the level of the third lumbar vertebra and did not move freely on roentgenoscopy. As the patient refused operation a definite diagnosis has not been made, but from analogy with another case, which is described, the author thinks it may have been neither a kidney nor a liver calculus but an area of calcification in the kidney parenchyma. The other case was in a patient aged thirty-five, in whom a ventrodorsal roentgenogram showed a large ovoid shadow the size of a pigeon's egg to one side and a little back of the spinal column a little external to the body of the 12th dorsal vertebra.

Clinical examination indicated a tumor of the kidney, so a diagnosis was made of kidney tumor with an area of calcification on the posterior surface of the upper lobe. Operation showed hypernephroma, a small nodule of which constituted the central non-calcified nucleus of the area of calcification and continued with the main body of the tumor through an opening in the lower side of the calcification.

PAZZI, ERMANNO. Diagnosis of tumor of the kidney (hypernephroma) confirmed by the roentgenogram. *Arch. di radiol.*, July–Aug., 1925, i, 591–592.

A good roentgenogram of the kidney region, even without pneumo-kidney, may show the form and position of a tumor and the greater or less clearness of its outlines. A case is described in a man of sixty-six, who for three months had had hematuria and lately pain in the kidney region. The kidney was found enlarged, ovoid, movable and painful. On roentgen examination the right kidney was found normal, in the left there was a large ovoid opaque mass with clear outlines which reached above to the middle of the lower border of the 10th rib and below to the transverse process of the 3d lumbar vertebra. Chromoscytoscopy showed kidney function abolished on the left, normal on the right. Pyelography showed kinking and dilatation of the ureter, dilatation and elongation of the pelvis, elongation and dilatation of the upper calyces, and moderate lengthening and dilatation of the lower calyces. This confirmed the clinical diagnosis of tumor of the kidney. The elongation of the calyces with little deformation of the papillae is characteristic of tumor, while in tuberculosis one of the first changes is an indistinctness of the outlines of the papillae. The tumor had invaded the upper half of the kidney, the upper pole being enlarged, while the pelvis was almost in its normal site. Operation and histological examination showed the kidney to be a hypernephroma. The patient recovered, and the other kidney functions well.

PERONA, PIETRO. Roentgenological observations on the hilus of the lung and the right margin of the heart and great vessels. *Radiol. med.*, November, 1925, xii, 764–769.

Perona has studied the changes in the shadow of the region of the hilus and the right cardiovascular margin during the revolution of the heart in a patient of fifty with organic heart block; he did not, however, show any changes in the aorta. Two roentgenograms are given showing the appearance of the hilus in diastole and in systole. In diastole the hilus shadow is not very clearly marked and its outlines seem a little indefinite, while in systole it is considerably clearer. French authors who have studied the hilus shadow in the cadaver found it almost invisible, and there is some analogy to this condition in the picture taken during diastole where the shadow is less visible than during systole because of the absence of the influx of blood from the pulmonary artery. The direction of the hilus is only slightly changed in the roentgenogram during systole, showing a somewhat greater tendency to become vertical on its axis, while on roentgenoscopic examination the impression is given that there is a marked outward thrust of the whole complex that makes up the hilus shadow.

Along the external margin denser shadows may be seen which are due to the shadow of the vessels, but which have sometimes been taken by inexperienced observers to be pathological changes in the hilus glands.

As to the right margin of the shadow of the heart and large vessels, some authors think it is formed only by the superior vena cava, others that it is formed by the ascending aorta and still others that the sinuous and slightly reentrant line immediately above the auricle is formed by the external border of the vena cava and the slightly convex line above it by the external border of the aorta. The author's roentgenograms tend to support the latter view. In systole it may be possible to distinguish the two vessels up as far as the 7th dorsal vertebra, but dissociation of the two is not possible above that level or in diastole.

The author thinks that the differences found in the living subject and in the cadaver may be due in part to the technique used. In the studies on the cadaver the vena cava and aorta were injected through the right jugular and carotid; the two vessels were completely dissociated. But he believes the results would have been different if they had been injected through the left ventricle, which would correspond with the conditions of pressure found during life.

PERUSSIA, FELICE. Atelectasis as a cause of opacity of the lungs to roentgen rays. *Radiol. med.*, December, 1925, xii, 820–826.

Perussia calls attention to the importance of atelectasis in causing opacity of the lungs, which may cause confusion in interpreting the roentgen picture. A characteristic example of this may be' seen in bronchial tumor. A very small bronchial tumor may cause atelectasis of the whole lobe, and the massive and uniform opacity of the lobe to the rays may lead the roentgenologist to make a diagnosis of tumor of the hilus with neoplastic infiltration of the whole lobe. When such a tumor is treated with

roentgen rays it may decrease in size until the bronchus is again permeable and the atelectasis may clear up, thus again giving a very wrong impression of what has been accomplished by the treatment. Other conditions are cited in which atelectasis may cause confusion in the picture, bronchostenosis from foreign bodies, compression of a bronchus from hemorrhage, compression from pneumothorax and collapse from disuse. He describes a case in which the whole left lung field appeared uniformly and densely opaque and hid the real cause of the condition, a large aneurysm of the aorta, which had caused complete stenosis of the left bronchus and atelectasis.

The atelectatic lung is uniformly opaque with a very dense shadow when the collapse is complete, and a less dense one when the collapse is partial. Since atelectasis is accompanied by decreased volume of the lung there is apt to be a retraction of the thorax on the collapsed side, a raising of the diaphragm and less movement of the diaphragm on respiration. The mediastinum in atelectasis from bronchostenosis is displaced toward the diseased side and it shows a pendulum movement during respiration, moving toward the side of the atelectasis on inspiration and toward the opposite side on expiration. Nevertheless differentiation of opacity from atelectasis and opacity from other causes is always difficult and often impossible. Recently injection of iodized oil into the respiratory tract has been made use of to aid in the differentiation.

Piccinino, Guido. Eventration of the diaphragm. *Arch. di radiol.*, July–Aug., 1925, i, 610–622.

A patient aged fifty-three complained of pain in the epigastrium and some difficulty in swallowing, especially solid foods. These symptoms began suddenly about seven months ago. The roentgen picture showed a considerable elevation of the left half of the diaphragm. Its outline was regularly spherical and it remained almost completely immobile on respiration. The space beneath this line was completely filled by the stomach, enormously distended with gas. There was some difficulty in deciding between eventration and hernia of the diaphragm. The differential signs generally given are (1) Glaessner's sign, that is, if there is a second line running parallel to the outline of the cupola of the diaphragm it indicates eventration; it is caused by the diaphragm adapting itself to the stomach and colon and giving a double outline. But it may appear in hernia also from a special arrangement of the herniated viscera. (2) The movement of the diaphragm is paradoxical in hernia, while in eventration it is normal, but decreased in amount. But this sign is not absolute either. In the above case a diagnosis of eventration was decided upon because, assuming that it was hernia, it involved the whole diaphragm and such an extensive hernia would have hardly allowed only the stomach to pass through it. Another case is described in a patient aged forty, in which it was difficult to decide between hernia and eventration. The regularity of the curve which separated the thoracic and abdominal cavities, a regularity which was not changed by changes in the gaseous contents of the stomach, and the history which excluded trauma, were signs which favored eventration. A third case is described in a patient aged fifty in which the condition was clearly eventration. The first roentgen examination showed the left half of the diaphragm lower than the right and a tumor of the mediastinum. This tumor was given roentgen treatment. It improved greatly and finally disappeared. On successive roentgen pictures the left half of the diaphragm became higher and higher until it was considerably higher than the right; respiratory mobility was finally abolished. Another case is described in a patient of twenty-four, also due to tumor of the mediastinum. Other cases of eventration of the diaphragm are due to lesions of the phrenic nerve. The idiopathic cases are probably caused by a defective development of the muscle tissue of the diaphragm.

Rejsek, Joseph. Diagnosis of papilloma of the pelvis by pyelography. *Arch. ital. di urol., Bologna*, December, 1924, i, 405–414.

Papillomata are frequent in the bladder, but rare in the pelvis and ureter. The author records a case in a woman, aged forty-eight, who had always been well until about a year ago when she began to have attacks of intense pain in the left flank, radiating into the sacral region and genitalia. The attacks were accompanied by hematuria and lasted only a day. When she came for treatment total hematuria was the only symptom. General examination was negative. The left kidney was not palpable; the lower pole of the right was palpable; it was smooth and painful on pressure. The urine contained a great deal of bright red blood. Indigo-carmin appeared on the left side in seven minutes and did not appear on the right in fifteen minutes. When the patient was put to bed the hematuria stopped. A roentgenogram of the kidney was negative for calculus, so the only possible diagnosis was renal neoplasm. The intensity of the hematuria and the absence of increased size of the kidney suggested papilloma of the pelvis. Pyelography confirmed the diagnosis. The pelvis, which was the shape

of a sector of a disc showed a dilatation of the intrarenal type. Its outlines were well-defined, except near the upper pole where there was a defect in the shadow the size of a nut. The calyces were flattened, the upper ones almost disappeared. The neck of the pelvis was free, the ureter was dilated and followed its normal course.

The kidney was removed and the wound sutured without drainage. There was complete recovery in ten days. The kidney was normal in size, the pelvis was dilated; the medulla was reduced, while the cortex showed no lesion. In the upper half of the pelvis there was a pedunculated tumor the size and form of a large strawberry. There was no infiltration of the wall around the papilloma. In the lower pole of the pelvis there were two organized white clots adherent to the mucosa. Microscopic examination showed a papillary epithelioma.

There are not many cases in which papilloma of the pelvis has been diagnosed by pyelography. Cases have been reported by Herbot and Miller, Braasch and Stevens, but these authors as well as Marion, say that organized blood clots in the pelvis may give the same picture as papilloma. Rejsek finds, however, that all of their cases were quite far advanced and the tumor had invaded the whole kidney. He thinks diagnosis by pyelography is quite possible in small papillomas in the beginning of their development. Of course other symptoms must be taken into consideration, such as hematuria, which is more abundant than in other conditions and generally painless, though some cases of kidney colic have been reported, caused either by obstruction of the ureter by blood clots or by villosities of the tumor obstructing the outlet of the pelvis. In papilloma of the bladder, if there is hematuria, it suggests the possibility of papilloma of the ureter or pelvis and examination should be made for it. Another diagnostic sign is the discovery by microscopic examination of small shreds of papilloma in the urine.

SAPUTO, VINCENZO. Signs of healing in pulmonary tuberculosis as seen in the roentgen picture. *Radiol. med.*, January, 1926, xiii, 13–26.

Clinical diagnosis of recovery in pulmonary tuberculosis is extremely difficult and a considerable amount of work has been devoted to endeavoring to find roentgen signs that would show definitely that cure has taken place. There is still much difference of opinion among clinicians and roentgenologists as to the validity of these signs, but certainly sclerosis and calcification are evidences of healing in tuberculosis and both sclerosis and calcification can be shown in the roentgenogram. But the demonstration of sclerosis is of value only for that region of the lung which is sclerosed, that is, it does not prove that there is not an active tuberculous process in some other part of the lung. Moreover Jaquerod asserts that when tuberculous lesions heal the lung may resume its normal permeability to the rays instead of undergoing sclerosis. He examined a series of patients who had hemoptysis and bacilli in the sputum and after fifteen to seventeen months found that all trace of the old lesions had disappeared.

The hyperplastic process following a therapeutic pneumothrax often represents a definite process of healing. Different authors are agreed that after pneumothrax the lung presents zones of decreased clearness with a more or less diffuse shadow, alternating with zones of absolute opacity and more or less displacement of the mediastinum, and especially of the heart.

Signs of calcification with very clear outlines and very deep shadow are of greater value as evidences of cure than sclerosis.

Part of the difference of opinion among roentgenologists as to the value of the signs of cure in tuberculosis is undoubtedly due to differences in technique of examination. Series of pictures are of much greater value than single pictures, as they show the progress of the process of healing.

SCADUTO, G. The serious damage which may be done by prolonged immobilization in the treatment of diseases of the bones and joints in young subjects. *Arch. di radiol.*, July–Aug., 1925, i, 665–672.

A case is described in which a young man of nineteen was subjected to prolonged immobilization—lasting for two years altogether, including the immobilization prescribed at the sanitarium and the forced immobilization from inability to use the joints since—which resulted in ankylosis of various joints. Roentgenograms show a process of diffuse osteosclerosis which has led to ossification of the joint cartilages with serious functional results. In this case there is no doubt that the prolonged immobilization was the chief, if not the only cause of the serious anatomical and functional changes. Great care should be exercised in prescribing prolonged immobilization in young subjects. Bardenhauer says that as a result of prolonged immobilization the bone undergoes a process of rarefaction; the joints become rigid or even ankylotic, the synovia become dry and rough, the joint ligaments retract and limit movement, the tendons which are the active ligaments of the joint are affected with tenosynovitis, the superficial aponeurotic fascia becomes sclerotic

and restricts the movements of the limb still more.

Schuster, Julius. Ventriculography with lipiodol ascending and descending. *Klin. Wchnschr.*, Oct. 22, 1925, iv, 2064–2066.

Provided the patient is suitably prepared the method of ventriculography is entirely safe, and in cases of suspicion of tumor should be undertaken very early. Taken in conjunction with careful clinical observations, this method of study can help establish a diagnosis by revealing finer anatomical characters within the skull. The pictures must of course be correctly interpreted and although this is often difficult it can be satisfactorily accomplished with practice. Brain tumors, even when no bigger than a pigeon's egg, can be definitely diagnosed in well-taken roentgenograms.

Ventriculography either with air or with lipiodol ascending and descending is considered safer for a patient than encephalography. Diffuse processes in the brain can be brought out with the aid of modern apparatus and the Bucky diaphragm. Such processes in a frontal lobe are well brought out. It is emphasized that attention should be paid to the finest changes in the parietal and occipital lobes.

According to the author's experience epilepsy gave rise to the most varied roentgenographic pictures. Frequently there was a chronic hydrocephalus with normal cranial size; tumors; changes in the central convolutions and their surroundings; diffuse disease of one hemisphere; narrowing of the lateral ventricles, especially of the posterior horns and of the inferior horns.

Ventriculography is indicated in cases where very little air can reach the lateral chambers because of narrowing of the foramina of Luschka and Magendie. Two c.c. of lipiodol can be introduced directly into the lateral chambers without injury to the patient. The method has the advantage that the patient may be moved while under the roentgenoscope and the movements of the lipiodol followed.

Sgrosso, Salvatore. Contribution to the roentgen therapy of the deep membranes of the eyeball. *Arch. di radiol.*, July–Aug., 1925, i, 623–633.

The author describes 6 cases of pigmented retinitis and circumscribed edema of the retina in which roentgen treatment was used with excellent results, particularly brilliant in the 2 cases of pigmented retinitis in which the course is generally progressive. While the circumscribed edema of the retina might have been cured in other ways, it was cured in a very short time by the roentgen treatment. While it is impossible to say as yet just what is the mechanism of the action of the rays in these cases, the author believes that the rays have a stimulant action on tissue not yet completely differentiated and that they favor the elimination of products of cellular metabolism. He thinks that in the two cases of pigmented retinitis the cure was due to a stimulant action on nerve elements not yet completely degenerated, while in the cases of circumscribed edema it was due to an increased metabolism which caused a more rapid absorption of products of catabolism. Of course when there is complete atrophy of the retina the treatment is ineffective, as it was in his Case iv in which there was not only complete degeneration of the retina but serious disturbances of nutrition of the eyeball and scintillating synchysis. There was very great increase in vision in the first 3 cases, failure in the fourth, and in the fifth and sixth complete and rapid resumption of normal function.

Terhune, R. W. Physical and *x*-ray diagnosis of some cardiac conditions. *Indianapolis M. J.*, January, 1925, xxviii, 1–6.

In mitral insufficiency the roentgen ray reveals a rather uniform, smooth, circular enlargement to the left, and a general oval contour that is fairly characteristic. This increase in size to the left is sometimes very great but there is not the downward extension of the apex that is so characteristic of aortic insufficiency.

Typical mitral stenosis produces a type of heart, called the "boxing glove" heart because of its fancied resemblance to a clenched fist, the prominence of the right heart corresponding to the knuckles of the little finger. The fact that stenosis is so often associated with mitral insufficiency causes the area of dullness and the roentgen-ray picture of mitral stenosis quite often to vary from this classical type. There is an increase in the diameter of the right heart. This increase in size to the right is found in the fourth interspace, and to be of significance it should be greater than 3 or 3.5 cm. from the midline. In pure mitral stenosis this enlargement to the right is as characteristic as enlargement to the left is in mitral insufficiency. Frequently there is an enlarged left ventricle.

Aortic insufficiency produces a very large heart of characteristic shape known as the "wooden shoe" heart. The principal involvement is of the left ventricle; the right ventricle is relatively small and the right heart is not enlarged. The apex is low and far to the left; the blood pressure is quite constantly characteristic.

Uncomplicated aortic stenosis is a rare condition. The heart area is much increased to the

left. This is especially true in the early stages but as time goes on there is an increase in size in all dimensions. This heart lesion is often accompanied in old persons by an emphysematous condition which obscures the findings by percussion, but the size of the heart is made plain in the roentgenogram.

Apart from valvular defects, hypertrophy of the heart may be caused by such conditions as nephritis, essential hypertension, arteriosclerosis, overwork and overdrinking.

UTILI, VOLTURNO. A case of idiopathic submesocolic stenotic periduodenitis. *Radiol. med.*, January, 1926, xiii, 10–13.

The author examined a laboring man of fifty-two, who complained of emaciation, headache, weakness so great that he could hardly do his day's work, nervous depression and pain in the abdomen, without any definite symptoms indicating disease of the stomach, duodenum or biliary tract. Roentgen examination showed the stomach normal, but when the opaque liquid passed into the bulb of the duodenum it was found to be larger than normal and displaced upward. After an interval longer than normal the liquid passed from the bulb to the immediately subjacent segment of the duodenum, forming a large lump and then passing farther down to form another and so on, until it passed into the jejunum. This succession of filling and emptying of different segments made the duodenum look like a string of sausages to the right of the pylorus; it had lost its normal arrangement and its characteristic angles. This was evidently a case of stenotic essential periduodenitis in which there are veils or membranes, or sometimes solid cords constricting the duodenum and interfering with the passage of food from one segment to the next.

VALLINO, MARÍA TERESA, AND MACERA, JOSÉ MARÍA. A case of multiple exostosis and fibroadenoma of the breast. *Semana med., Buenos Aires*, Aug. 27, 1925, xxxii, 489–492.

A girl of thirteen came to the hospital with a greatly enlarged left breast which was found to be the site of a cystic fibroadenoma. Her birth and development had been normal, and she had begun to menstruate six months before; the unusual development of the breast had taken place within the past three months. A number of exostoses were found on the long bones, which had not caused any symptoms. Her mother and one brother had the same bone lesions.

This affection of the bones is one that always takes place during the years of growth. It is familial but not congenital. The exostoses are generally at the level of the articular cartilages and often, as in this case, cause no symptoms; if they affect the bones of the head they may cause compression of the brain. One case is reported of an exostosis on the anterior surface of the scapula which compressed the pleura and caused pain at the apex of the lung, leading to a diagnosis of tuberculosis. Cases have also been reported in which there was compression of the medulla. The cause is not known.

TESCOLA, CARLO. Ulcerative gastric lesion from foreign body. *Radiol. med.*, January, 1926, xiii, 5–10.

The patient was a young woman of twenty, who came for roentgen examination on account of serious symptoms of ulcer of the stomach and in whom screen examination and roentgenograms unexpectedly showed the shadow of a part of a needle which she had swallowed eight months before, which had caused the morbid process, and which was located in the epigastrium in immediate contact with the outline of the stomach.

VESPIGNANI, ARCANGELO. Roentgenological diagnosis of chronic mesenteritis. *Radiol. med.*, October, 1925, xii, 675–700.

Chronic mesenteritis can now be recognized before operation, thanks to the roentgenological signs discovered by the author and confirmed on operation by Donati. There are three groups of signs: (1) those of the duodenum; (2) those of the colon, and (3) those of the small intestine. The duodenal signs consist of stasis and dilatation of the inferior part of the duodenum, motor insufficiency of the duodenum and deformation of the duodenojejunal angle which may be rendered very acute by deviation to the right of the first loop of the jejunum. The second consists in modifications in the form and position of the colon. There may be a deviation upward and toward the midline from retractile mesocolitis. Four cases of mesenteritis are described with numerous illustrative roentgenograms. But there is also a diffuse stasis due to a paralytic state of the colon in mesocolitis which is analogous to the paralysis of the small intestine observed in mesenteritis. The signs in these two first groups are analogous to those described previously by the author for retractile and adhesive mesenteritis of Donati's submesocolic fossa. The third group of signs is the one that is most typical of chronic mesenteritis and consists of segmental paralytic dilatations of the small intestine. These dilatations can be readily distinguished from prestenotic dilatation by several roentgenological characteristics. They are multiple

and interposed between tracts of normal intestine. The dilated tracts may be short even when there is an advanced degree of dilatation, while in prestenotic dilatation there is a certain amount of parallelism between the degree of the dilatation and the length of the dilated tract. The dilatation is almost uniform throughout its length, while in prestenotic dilatation the caliber of the dilated segment is always greater immediately in front of the stenosis. It is almost always possible to demonstrate that the dilated part passes into normal intestine without any intervening stenosis. In prestenotic dilatation Kerkring's valves are deep and well defined until the dilatation reaches an extreme degree, while in dilatation from mesenteritis they either disappear completely or are very much flattened out. As Kerkring's glands are functional structures and not fixed anatomical ones and as dilatation in mesenteritis is especially due to lesions of the nerves of the mesentery it is natural that these glands should flatten out or disappear with relaxation of the muscularis propria and the muscularis mucosae. The movements of the dilated loop are also changed. In dilatation from mesenteritis they are sluggish and insufficient and remain so continuously, while in prestenotic dilatation there are frequent periods of restored or even excessive intestinal tonus with violent movement, even when the stenosis has reached an advanced stage. These roentgenological signs are the only objective means of diagnosing chronic mesenteritis before operation.

Viton, Alfredo. Roentgen symptomatology of the respiratory tract. *Semana med., Buenos Aires*, July 2, 1925, xxxii, 1–25.

Seventy-five roentgenograms are given showing various pathological conditions of the pleura, lungs, bronchi and mediastinum. The chief affection of the bronchi in which roentgenoscopy is valuable is bronchiectasis. The bronchiectatic cavities can be seen like strings of beads along the course of a bronchus. They can be distinguished from cavities of other origin by the characteristic size, form and appearance of tuberculous cavities and by the clinical data. Roentgen examination of the lungs gives characteristic pictures in tumors, abscess, pneumonia, pneumothorax and the various stages of tuberculosis. In emphysema, which may be of tuberculous origin, there is transparency of the enlarged lung fields, the ribs are not very clearly visible, the intercostal spaces are wide and the excursions of the diaphragm reduced. Lobar pneumonia may affect a part or all of a lobe, or various lobules at the same time. It may be unilateral or bilateral and affect the apex, the hilus or the base. There is a well-defined shadow corresponding topographically to the affected part. The roentgenoscopic shadow of pneumonia may be confused with that of pulmonary abscess, pulmonary gangrene, etc., but the shadows in the latter are not so clearly defined and the clinical symptoms are different. Tumors of the lung may be benign or malignant. Hydatid cyst is benign and appears as a rounded shadow suspended in healthy lung parenchyma. If it suppurates the shadow may be more diffuse and the outlines less well defined. Sarcoma may be confused with hydatid cyst roentgenoscopically but the clinical course is different. Tumors of the lung, in general, give diffuse shadows with an early tendency to invasion. Syphilis is hard to distinguish from tuberculosis roentgenologically but if there is an aortitis and the pulmonary shadow has a sclerotic character the presumption is in favor of syphilis. In bronchopneumonia there are diffuse shadows scattered over the lung fields corresponding to the zones of dullness found on percussion. The hilus glands may be enlarged by acute or chronic processes, the latter generally being syphilis or tuberculosis. The more the glands become calcified, the darker the shadows. There are three stages of tuberculosis, the beginning stage, the stage of softening and that of cavity formation. In the first stage, there is more or less extensive opacity of the lung fields, at the vertex, hilus, base or subpleural zones, depending on the site of the lesions. In the second stage the lung is spotted with dark and clear spots which alternate with zones of normal parenchyma; in areas where healing is taking place the glands are calcified. In processes which are progressive the shadows are generally extensive with ill-defined borders and a grayish, spongy appearance. In the third stage, on a background similar to the lesions just described, there are cavities which may be full or empty.

Dry pleurisies do not present an especially characteristic picture, only a local shadow, more or less extensive and more or less dense in the part affected by the lesion. Pleurisies with effusion show a shadow corresponding to the effusion, the upper limit of which is not horizontal but curved.

Villette, Jean. Chronic duodenal occlusion. *Arch. Franco-Belges de chir., Brussels*, 1925, xxviii, 11–40.

The roentgenogram after administration of baryta is used with great satisfaction in duodenal occlusion. The exact nature of the occlusion, as well as the extent of the condition, can be accurately determined in such roentgenograms. The alimentary tract in the region

affected may be studied also, as well as the activity of the pyloric orifice, the contractions, etc., so as to be able to determine the exact seat of the occlusion. In such cases, roentgenograms taken at various intervals after administration of baryta will give more information than a single picture. Watching the progress of the baryta through a screen also has its advantages. The necessary operative procedures may be accurately determined by this means. A large number of drawings are included to illustrate the various conditions to be noted in such cases.

VITON, ALFREDO. Roentgen symptomatology of the circulatory system. *Semana med., Buenos Aires*, July 9, 1925, xxxii, 64–80.

The author gives 53 diagrams showing the outline of the heart and large vessels in various pathological conditions. In general, roentgenoscopic images appear larger than the organs which they represent because of distortion of the rays, but this can be corrected by means of orthodiagraphy. The normal cardio-vascular shadow has a triangular form with the sides almost equal, suspended at its upper part by the great vessels, or vascular peduncle. Its base rests lightly on the diaphragm under normal conditions, only the central part touching the diaphragm and the sides arching upward, owing to the tonicity of the heart muscle. The heart comes into contact with both lung fields, making a deep indentation in the left one. Normally the heart gives a dark shadow, somewhat darker at the base than above, and the aorta is lighter in shade than the heart. If the aorta gives a black and not a grayish shadow it indicates atheroma. During inspiration the left third of the heart shadow lifts from the diaphragm and if this does not occur it indicates a certain degree of atony of the myocardium.

Pleuritic effusions of any kind push the heart to the opposite side and the same is true of hydro-, hemo- or pyopneumothorax. Ascites displaces the diaphragm upward, and also the heart and great vessels to a lesser degree. There is a difference in the pictures given by hypertrophy and dilatation of the heart; in the former the heart keeps its form and is enlarged in all diameters while in dilatation it hangs from the vessels like a purse full of a substance which flattens on the diaphragm. The diagrams show the form of the shadow in dilatation of individual heart chambers. In partial atony of the heart the shadow is triangular, the base having the same length as the transverse and longitudinal diameters. When the atony is total the form is "transverse," that is, the apex is deviated toward the axilla, and the large vessels may be said to be telescoped into the upper angle of the heart.'

VON CSAPODY, J. Arterial photographs with the aid of lipiodol. *Klin. Wchnschr.*, Nov. 26, 1925, iv, 2327.

Lipiodol is suitable for the study of the arterial distribution in the cadaver. The blood vessels are marked with incomparable sharpness. The lipiodol goes into the smallest branches and, what is very important, it remains there once it enters. The roentgenogram shows considerable contrast. (No actual observations are cited in this note.)

ALBERTI, OLINDO. Trauma of the first cervical vertebrae. *Radiol. med.*, February, 1926, xiii, 96–129.

Two cases are described, one of bilateral anterior luxation of the atlas with fracture of the odontoid process of the axis and one of pure fracture of the odontoid process of the axis, without dislocation, both of them being due to trauma and neither of them showing any signs of compression of the spinal cord. Such dislocations are almost always due to a fall or blow on the head, with flexion of the head in case of forward dislocation and hyperextension in case of backward dislocation. A latero-lateral and an anteroposterior picture should be taken through the open mouth. Normally the shadow of the posterior arch of the atlas, that of the laminae and spinous processes of the axis and the lower border of the base of the occiput form three parallel lines. In luxation there may still be more or less parallelism between the occiput and the atlas, but the lines of the altas and axis if prolonged forward would intersect, forming an angle more or less obtuse backward. The anterior tubercle of the atlas which lies normally in the line joining the anterior margins of the cervical vertebrae is displaced so as to lie in front of this line and displaced downward in front of the body of the axis, sometimes so far as to touch the body of the third veterbra. There may be concomitant fractures which will show on the picture and it is well to use a diaphragm to bring out more clearly the details of such fractures and to get a clear picture of the odontoid process between the lateral masses of the atlas. There is a more or less marked lordosis of the cervical column. The author took a series of pictures of one of his cases up to a year and a half after the accident to determine whether this lordosis was produced immediately by the accident or whether it was progressive, but found no change in it.

Prognosis should be reserved in these cases for there may be spontaneous progress of the luxation or a later slight accident may bring about enough luxation to produce fatal results. Moreover the hypertrophied callus of the fracture of the odontoid process may in time cause signs of compression. The treatment is chiefly immobilization, at first with plaster and later with a lighter material, such as celluloid or leather. Reduction may be indicated in certain cases but it is not without danger and has even sometimes caused death. It should be used only in cases where there are signs of compression and should then be limited as far as possible to simple extension. Operation may be indicated when there are signs of progress of the dislocation. In such cases good results have been obtained by fixation of the posterior arch of the atlas to the spinous process of the axis.

Roentgenology has shown that these fractures and dislocations are much more frequent than was formerly believed and also that they are much less serious than has been supposed. It has been found that many cases exist without any signs of compression of the spinal cord.

Arens, Robert A., and Bloom, Arthur R. The normal and pathological appendix. *Radiology*, December, 1925, v, 513–519.

A clinical roentgenological study is presented. The 48 cases in Group I had a roentgen diagnosis of chronic appendicitis and these patients were operated on. Group II comprised 35 cases in which the roentgen diagnosis of chronic appendicitis was made, but no operation followed. Group III contained 102 cases who had no history of intestinal symptoms and were considered normal controls. The patients in the first two groups were purged previous to ingestion of the contrast meal, while those in Group III were not purged. The appendix was visualized as frequently in Group III as in the others. The normal appendix is usually not visualized by roentgen rays; but when visualized, it is found to empty within a reasonable time after the cecum. It is freely mobile and there is no tenderness.

Roentgen findings of chronic appendicitis are usually those of a visualized appendix which is tender on direct palpation. There may or may not be limited mobility, nondrainage, or abnormal location. In those cases in which the appendix is not visualized the cecum is definitely and exquisitely tender.

Symptoms of chronic appendicitis consist of abdominal pain, nausea, vomiting, belching, gastric distress in relation to meals, and in a large precentage of cases, a history of previous attacks may be obtained. Pathological findings are usually those of adhesions, congestion, edema of the mucosa and fecaliths.

The appendix was visualized in 84 per cent of the cases of Group I and 86 per cent in Group II. The barium was retained in the majority of instances for forty-eight hours or longer. In Group III there were 78 individuals under thirty years of age, and in 36 of these the appendix was visualized. There were 24 persons over thirty years of age and in only 3 of these was the appendix visualized. These findings tend to substantiate the observation that the normal appendix is not visualized after thirty years of age.

Four case reports are briefly cited.

Arpási, A. A simple method for demonstrating adhesions of abdominal organs in the roentgenogram. *Münchn. med. Wchnschr.*, Oct. 9, 1925, lxxii, 1734.

With the aid of pneumoperitoneum loose adhesions in the abdominal cavity may be visualized; but simple roentgenoscopy will not disclose such adhesions which are definitely present after many operations. Such loose adhesions will not escape observation during roentgenoscopy if examination is made not *after* the administration of the whole contrast meal but during its consumption. The patient should be examined preferably after half of the contrast meal has been given and then after the meal is completed.

Such an examination as outlined has always disclosed the loose adhesions after abdominal operations. These adhesions permit the ptotic stomach to sink as far down as the symphysis, whereas denser adhesions fix the stomach high up in the abdomen. When the stomach contains only a little of the contrast material it moves toward the right and retains its tonus. As soon as it receives more of the barium meal, it sinks in proportion to its tone.

Attilj, Sordello. Roentgenological study of two cases of pseudohermaphroditism. *Radiol. med.*, February, 1926, xiii, 77–81.

The author describes 2 cases of external female hermaphroditism in two sisters of whom he made systematic roentgen examinations and found changes of a nature which he has not found mentioned anywhere in the roentgen literature. These changes consisted of very early ossification of the centers of ossification which gave the bones the appearance of those ordinarily seen in individuals of twelve and eighteen years of age instead of four and seven years, which were the ages of these two sisters. He believes that their condition was due to hyperfunction of the suprarenal cortex. The cases are interesting from the point of view of

endocrinology, especially as they occurred in two sisters. The parents were normal.

BRICKNER, WALTER M. Attenuated bone infections. *J. Am. M. Ass.*, Dec. 5, 1925, lxxxv, 1782–1788.

The phenomenon of attenuation and longevity of pathogenic bacteria in the bones is well illustrated in the chronic bone abscess; and it is to be observed in other latent local and metastatic foci of osteomyelitis. In these conditions especially it affords opportunity for conservative surgery—drill drainage of non-perforating chronic bone abscesses, incision of subperiosteal abscesses, and simple sequestrectomy. The important pathologic process in chronic osteomyelitis is bone necrosis which is causally related to suppuration. When the necrosed bone escapes or is removed the suppuration usually ceases.

In the surgery of chronic osteomyelitis the bone itself should not be attacked until a sequestrum has definitely formed. In addition, the simple removal of sequestra may be all that is necessary to effect healing. Osteotomy cannot be applied in all situations to eradicate bone cavities which, however, sometimes close up or close over spontaneously.

Chronic bone abscesses may be medullary or cortical, may be at any level of the bone and are rarely tuberculous. Their symptoms are pain and bone tenderness and occasionally slight fever. Such abscesses are usually residual from, and give symptoms years after, an acute osteomyelitis. There is illustrated, however, a series of solitary, chronic, sterile cortical abscesses without any discovered antecedent infection. Non-perforating chronic bone abscesses are usually sterile or nearly so. Osteotomy is therefore not necessary for their cure. The author's method of treatment by simple evacuation through a small drill hole has been uniformly successful even in non-sterile cases. Four cases are described and discussed.

CAMP, JOHN D. Sarcoma complicating osteitis deformans: A report of two cases. *Radiology*, December, 1925, v, 495–499.

The two following cases observed in the Massachusetts General Hospital within the last year are reported because of the rather localized changes present in the one, and the extensive involvement in the other.

The first case occurred in a white laborer, aged seventy, complaining of pain of one month's duration in the left thigh. A history of trauma received three months previously was obtained. There was considerable loss in weight. A roentgenogram of the right femur showed no variation from the normal. The left femur was definitely increased in size, showed much cortical thickening and areas of increased and diminished density throughout the greater portion of the shaft. Extending into the soft tissues from the mid-posterior surface were areas of increased density with definite ray-like formation. The process appeared to be almost wholly confined to the left femur, although the pelvis showed just below the left acetabulum, a small area of mottling. Films of the other bones were normal. The roentgenological diagnosis was that of osteogenic sarcoma of the left femur superimposed upon Paget's disease. The patient received roentgen treatment, but there was no immediate reaction to the treatment and he failed to return for further observation.

The second case occurred in a mechanic, aged sixty, who complained of swelling and severe pain in the left arm and shoulder. The roentgenograms showed the bones to be large and the margins rough where the muscles were attached. The arteries showed rather extensive calcification. The right innominate bone showed an increase in size and density, with a rather characteristic mottled appearance. The lower lumbar spine was more dense than normal. In the upper third of each humerus the bones were increased in size, showed coarse irregular trabeculation and considerable mottling. About the left humerus was a large soft tissue tumor. The bone was eroded beneath it and a pathologic fracture extended through the shaft below the surgical neck. The right tibia appeared wider and denser than the left. Films of the skull and hands were negative. The chest showed multiple, round, dense, sharply defined masses characteristic of metastatic malignant disease, scattered throughout both lung fields.

Roentgenograms in this instance are interesting inasmuch as they reveal a rather diffuse involvement, the usual picture of Paget's disease, and well-advanced malignant disease, as evidenced by the lung metastases. Since no primary source of malignancy could be demonstrated, the diagnosis of osteitis deformans with superimposed sarcoma of the left humerus seemed the most plausible diagnosis.

CAMP, JOHN D. The sella turcica; the significance of changes in its roentgenographic appearance. *J. Am. M. Ass.*, Jan. 16, 1926, lxxxvi, 164–168.

Observations based on anatomic specimens and roentgenograms show the normal sella to vary in contour and size. Variations in contour may be divided into three types, the

round, oval and flat, of which the oval type predominates in the adult.

The average sella will measure 1.06 cm. anteroposteriorly and 0.81 cm. vertically. Variations in the shape of the clinoid process are numerous, and union between the anterior, middle and posterior clinoids, producing a bridged sella, occurs in about 5 per cent of cases. Such an anatomic variation seems to be of no clinical significance.

Pseudo-defects and apparent anomalies of structure are easily produced in a roentgenogram by faulty localizing technique. Pathologic conditions producing changes in the sella are numerous and the differentiation of these changes as to cause is often difficult. Owing to the characteristic deformity of the sella usually produced by each, the differentiation between an intrasellar and an extrasellar lesion is generally possible. Intrasellar tumors enlarge the sella in a uniform circular manner at the expense of the floor and dorsum sellae. The former is slowly eroded until a pouching into the sphenoidal sinus occurs with total destruction of the intervening bone. Roentgenograms at this stage show the outline of the floor to be represented by a double line. The higher line represents the lateral border of the fossa, while the lower one is produced by the lower border of the tumor as it stands in contact with the air in the sphenoidal sinus. In advanced cases the dorsum sellae may entirely disappear. Then it is difficult to differentiate the changes produced by a large pituitary tumor from those provoked by pressure from an extrasellar lesion. In contradistinction to the characteristic deformity of intrasellar tumors, the pressure associated with extrasellar tumors produces a widened and flattened sella.

The above observations are based upon 110 specimens removed at necropsy and compared with their roentgenograms.

DeBuys, Lawrence R.; Samuel, Ernest C.; and Bowie, Eleazar R. Thymus and the treatment of its hyperfunction. *J. Am. M. Ass.*, Nov. 14, 1925, lxxxv, 1551–1553.

A study of the thymic shadow in the roentgenogram was undertaken at the Touro Infirmary, New Orleans, about three years ago with the idea of arriving at some definite conclusions as to the size, shape and position of the thymus from birth onward. Examinations were made beginning during the first twenty-four hours after birth, and an endeavor was made to discover the cause of the peculiar syndrome that is now and then seen in children.

The roentgenogram of the thymic area was made with double intensifying screens, tube plate distance 36 inches, 80 ma., and 85 to 90 kv. This examination was repeated at the age of three, six, nine and twelve months and again in the second year. A few of the cases have been observed for a three-year period.

It has been impossible as yet to arrive at a definite standard of size, shape or position of the gland causing symptoms. There were some patients with all the effects of a hyperfunctioning thymus, which when examined showed only slight enlargement; whereas other cases in the series with marked enlargement of the gland showed no clinical manifestations. The heart shows no relation in size to the thymus although marked thymic enlargement is rarely seen without an increase in the size of the right side of the heart.

In a large number of cases the shadow of the thymus is seen to the right and left with large, finger-like projections overlying the right side of the heart. In the diagnosis of cases the roentgen-ray findings are considered of paramount importance. Occasionally negative findings have been unsatisfactory and semilateral roentgenograms of the chest were made to bring out the enlarged gland that merges with the shadow of the aorta.

It is amazing what some roentgenograms will show in the first twenty-four or forty-eight hours after birth. The diagnosis of congenital heart disease should not be made too readily without considering the thymus as a causative factor.

When diagnosis of enlargement of the thymus is established treatment is either with roentgen or radium rays. Theoretically radium is preferable for children as it can be firmly fixed in the desired location no matter how restless the child. This treatment employs 100 mg. of radium element in 2 mm. brass filter, held at a distance of 5 cm. from the skin and firmly fixed in place by adhesive plaster reinforced by a binder. The duration of exposure varies from eight to twelve hours, depending upon the size of the thymus as well as the age and size of the child. Anterior applications have been the rule, although when a series of three radium exposures was given the first dose was usually applied anteriorly and the second dose posteriorly, and finally back again to the anterior chest wall. The interval between applications has usually been from ten days to two weeks unless the condition was grave. If three applications result in no improvement the case is regarded as not amenable to irradiation. However, this treatment has been uniformly successful and rarely have more than three or four applications been required. No ill effects have been observed either with radium or roentgen irradiations.

The method of choice in thymus irradiations

is with roentgen rays. Various forms of technique have been tried and the one selected is as follows: Uniform exposures are given for one minute with rays produced by 5 ma., 7 in. gap, though 1 mm. Al, 10 in. distance, giving approximately one-tenth of a skin unit. The average number of exposures required is between four and five. The number of treatments required is determined primarily by the symptoms, and to a distinctly secondary degree by the size of the thymus as seen in the roentgenogram. It was frequently found that the gland decreased very slowly after complete and permanent disappearance of the clinical picture. No case of thymic enlargement has yet been encountered that has not been controlled by roentgen therapy. The only difficulty attendant on the roentgen therapy of the thymus has been the restlessness of the child.

Out of a total of 623 children irradiated at various ages from birth to thirty-nine months, 125 cases of thymic enlargement have been observed. These cases of thymic enlargement have had an average of three control examinations. Only in about a third of the cases was there a necessity for control examinations extending beyond a period of six months.

GRAHAM, EVARTS A.; COLE, WARREN H.; COPHER, GLOVER H.; and MOORE, SHERWOOD. Simultaneous cholecystography and tests of hepatic and renal functions. *J. Am. M. Ass.*, Feb. 13, 1926, lxxxvi, 467–468.

An effort has been made to find a substance which would prove practical not only for visualizing the gall-bladder, but also would give sufficient color to the blood to permit its use for a test of hepatic function in a manner similar to the test devised by Rosenthal employing phenoltetrachlorphthalein.

There are two isomeric groups of halogenated phenolphthaleins. In one group the halogen is attached to the phthalein part of the molecule, and in the other group it is attached to the phenol ring. In either case the opacity to roentgen rays is the same but the former group of isomers possesses a more intense color.

It was natural therefore after finding that tetraiodophenolphthalein was a safe and practical agent for rendering the gall-bladder visible that the authors should turn to its isomer, phenoltetraiodophthalein, as a substance which might make possible the simultaneous performance of a test of hepatic function and cholecystography. The authors are now able to report that this last named compound permits good visualization of the gall-bladder and also stains the blood serum sufficiently to permit its detection after alkalization. Gall-bladder shadows of maximum intensity have been obtained within four hours in normal subjects after the intravenous injection of 0.055 gm. per kilo. The authors do not feel that there is yet sufficient knowledge to recommend the use of this substance as a substitute for tetraiodophenolphthalein for cholecystography and the information is presented only as a preliminary report. It is possible that further work with it will show that because of possibly faster excretion through the liver the use of this dye will shorten the time now required for cholecystographic examination.

Another feature of sodium phenoltetraiodophthalein is that in addition to being excreted in sufficient amount through the liver to give excellent cholecystograms it is also excreted sufficiently through the kidneys to enable its recognition colorimetrically in the urine after alkalization.